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Report of the Agricultural Experiment Station of the ...

California Agricultural Experiment Station

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REPORT

OF THE

COLLEGE OF AGRICULTURE

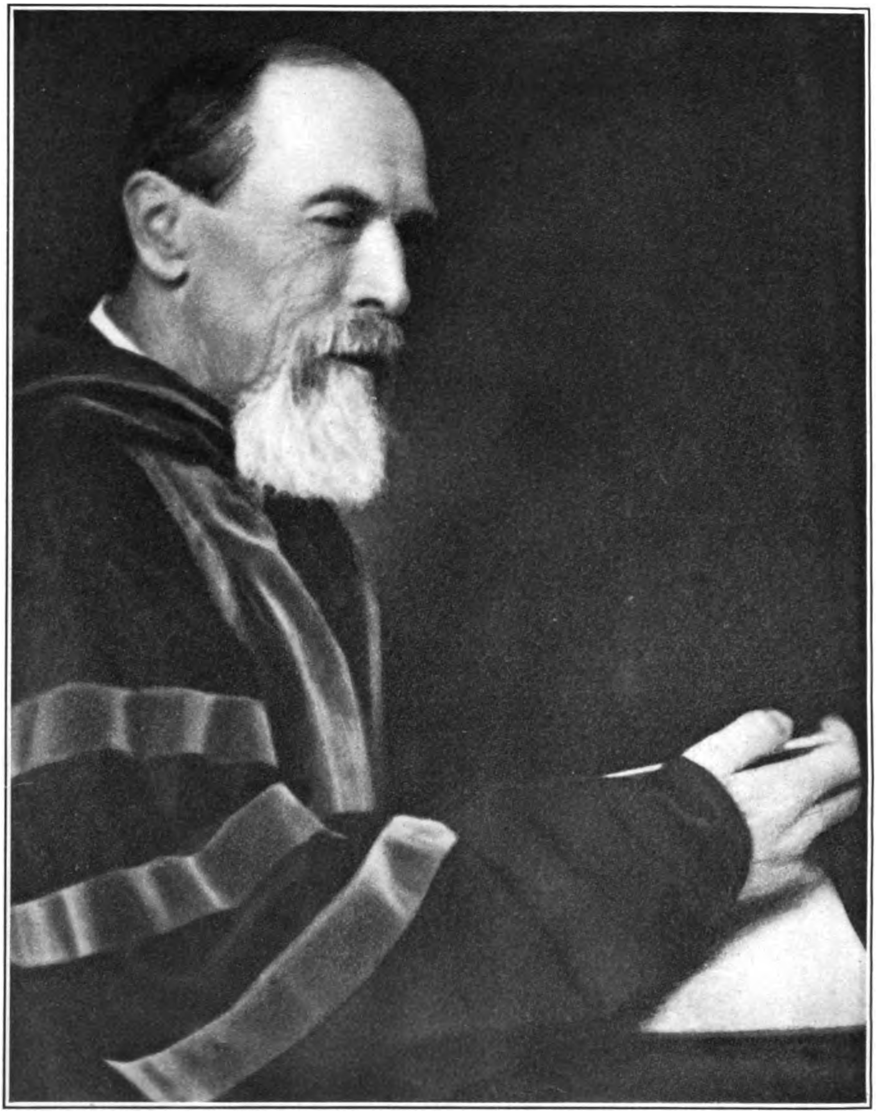
AND THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF CALIFORNIA

FROM JULY 1, 1912, TO JUNE 30, 1913



EUGENE WOLDEMAR HILGARD, Ph.D., LL.D., Emeritus Professor of Agriculture of the University of California; Organizer of the Agricultural Department of the University and Founder of the University Agricultural Experiment Station, 1875, and Director thereof, 1875 to 1905; Dean of the College of Agriculture, 1897 to 1905. See page X.

UNIVERSITY OF CALIFORNIA PUBLICATIONS

REPORT

OF THE

Univ.

COLLEGE OF AGRICULTURE

AND THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF CALIFORNIA

FROM JULY 1, 1912, TO JUNE 30, 1913

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AGRICULTURAL STAFF*

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Lillian D. Clark, Assistant in Agricultural Extension.

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C. F. Grauel, Orchard Foreman, Davis.

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F. M. Hayes, D.V.M., Assistant Professor of Veterinary Science.

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Cora J. Hill, Assistant in Dairy Testing.

F. E. Hill, Foreman, Forestry Station, Santa Monica.

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W. G. Hummel, M.S., Assistant Professor of Agricultural Education.

Thomas Francis Hunt, B.S., Assistant Superintendent Farmers' Institutes.

H. L. Hurst, Buttermaker, Davis.

R. C. Ingrim, Instructor in Shop Work, Davis.

O. W. Israelsen, B.S., Assistant in Irrigation in co-operation with the Office of Experiment Stations, Davis.

J. Jacobsen, Foreman of Repairs, Davis.

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* As of Sept. 1, 1913.

Adele S. Jaffa, M.D., Lecturer in Dietetics.
M. E. Jaffa, M.S., Professor of Nutrition.
Katherine Jones, B.S., Assistant in Landscape Gardening.
T. R. Kelley, A.B., Instructor in English and History, Davis.
*O. J. Kern, Assistant Professor of Agricultural Education.
Jas. Koebер, Instructor in Farm Mechanics.
E. J. Lea, M.S., Assistant Professor of Nutrition.
C. B. Lipman, Ph.D., Professor of Soil Chemistry and Bacteriology.
W. E. Lloyd, B.S., Assistant in Poultry Husbandry, Davis.
R. H. Loughridge, Ph.D., Professor of Agricultural Chemistry, Emeritus.
Anna M. Lute, A.B., Seed Tester, U. S. Dept. of Agriculture (in co-operation).
B. A. Madson, B.S.A., Assistant Professor of Agronomy.
L. K. Marshall, Assistant in Agronomy, Fresno.
W. C. Matthews, A.B., Instructor in Scientific Illustration.
Margaret Mayberry, Librarian, Davis.
C. H. McCharles, M.S., Assistant Professor of Nutrition.
A. McDonald, Stockman, Davis.
W. M. Mertz, Assistant in Pomology, Riverside.
M. R. Miller, B.S., Assistant Chemist in Insecticide Control.
C. S. Milliken, Field Agent in the Frost Damage Survey.
J. F. Mitchell, D.V.M., Instructor in Veterinary Science.
J. N. Moore, Foreman, Forestry Station, Chico.
D. N. Morgan, B.S., Assistant to the Director; Secretary of the College of Agriculture.
Earl Morris, Field Assistant in Santa Clara County.
J. W. Nelson, Assistant Professor of Soil Technology.
L. J. Nickels, B.S., Instructor in Insect Industries, Davis.
W. F. Oglesby, A.B., Assistant in Viticulture.
W. E. Packard, M.S., Experimental Agronomist, in charge of Imperial Valley Station, El Centro.
W. G. Perrine, Superintendent of Greenhouses and Gardens.
B. B. Pratt, B.S., Assistant Professor of Pomology.
H. J. Quayle, M.S., Assistant Professor of Entomology.
C. L. Roadhouse, D.V.M., Assistant Professor of Veterinary Science.
J. T. Rodgers, Farm Foreman, Davis.
S. S. Rogers, B.S., Instructor in Plant Pathology, Davis.
W. A. Setchell, Ph.D., Botanist.
L. T. Sharp, B.S., Assistant Professor of Soil Chemistry and Bacteriology.
C. F. Shaw, B.S., Professor of Soil Technology.
C. O. Smith, M.S., Instructor in Plant Pathology, Whittier.
Elizabeth H. Smith, M.S., Plant Pathologist.
R. E. Smith, B.S., Professor of Plant Pathology.
*R. T. Stevens, B.S., Assistant Professor of Landscape Gardening.
Guy R. Stewart, B.S., Assistant Professor of Agricultural Chemistry.
Mattie E. Stover, B.S., Instructor in Nutrition.
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Thos. Tavernetti, B.S., Assistant to the Dean of the University Farm School.
R. H. Taylor, B.S., Instructor in Pomology.
W. J. Taylor, D.V.M., Assistant Professor of Veterinary Science, El Centro.
E. E. Thomas, B.S., Assistant Chemist, Whittier.
J. I. Thompson, B.S., Assistant Professor of Animal Husbandry.
C. M. Titus, M.A., Instructor in Mathematics, Davis.
G. H. True, B.S., Professor of Animal Husbandry.
A. R. Tylor, B.S., Assistant Plant Pathologist, Whittier.
E. C. Van Dyke, B.S., M.D., Instructor in Entomology.
H. E. Van Norman, B.S., Dean of the University Farm School, Davis; Vice-Director of the Agricultural Experiment Station; Professor of Dairy Management.
W. H. Volck, Field Assistant in Monterey County.
E. C. Voorhies, B.S., Assistant in Animal Husbandry, Davis.
A. E. Way, Field Assistant in Viticulture, Fresno.
H. J. Webber, Ph.D., Director Citrus Experiment Station, Riverside; Dean of the Graduate School of Tropical Agriculture; Professor of Plant Breeding.
E. J. Wickson, M.A., Professor of Horticulture.
C. J. Wight, B.S., Instructor in Botany, Davis.
C. W. Woodworth, M.S., Professor of Entomology.
H. D. Young, B.S., Assistant in Agricultural Chemistry, Whittier.
C. J. Zinn, Assistant in Soil Technology.

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* Beginning October 1.

REPORT OF THE DIRECTOR

To the President of the University of California:

Sir:—I have the honor to report the work of the Department of Agriculture of the University of California for the year ending June 30, 1913.

Since this report covers the activities of the College and Station for the period mentioned, it should be noted that the Dean of the College of Agriculture and the Director of the Agricultural Experiment Station, from July 1st to October 1st, 1912, was Professor E. J. Wickson, on whom devolved the labor and responsibility of the Department for the first quarter of the year.

As a supplement to this report are submitted copies of all Experiment Station bulletins and circulars published during the year as follows:

Bull.	229	Hog Cholera and Preventive Serum, F. M. Hayes	16,000*
Bull.	230	Enological Investigations, F. T. Bioletti and W. V. Cruess	16,000
Bull.	231	Walnut Culture in California, R. E. Smith	16,000*
Bull.	232	Commercial Fertilizers, J. S. Burd	16,000
Bull.	233	Three Years Work of the Ferndale Cow Testing Association, Leroy Anderson	16,000
Bull.	234	Red Spiders and Mites of Citrus Trees, H. J. Quayle	20,000
Bull.	235	Further Proof of the Cause and Infectiousness of Crown Gall, C. O. Smith	20,000*
Bull.	236	The Economic Value of the Western Meadowlark in California, H. C. Bryant	20,000
Bull.	237	Pork Production under California Conditions, J. I. Thompson	25,000
Bull.	238	Selective Improvement of the Lima Bean, G. W. Shaw	16,000*
Bull.	239	The Culture of Tomatoes in California with Special Reference to their Diseases, S. S. Rogers	25,000
Cir.	80	Boys and Girls Clubs, E. B. Babcock, W. G. Hummel, F. L. Griffin	10,000
Cir.	81	Sweet Pea Growing Clubs, F. L. Griffin	8,000
Cir.	82	The Common Ground Squirrel in California, H. C. Bryant	20,000
Cir.	83	Potato Growing Clubs	20,000
Cir.	84	Mushrooms and Toadstools, W. A. Setchell	20,000
Cir.	85	Nematode Observed on Citrus Roots, E. E. Thomas	5,000

Cir. 86	Olives in Califotnia, F. T. Bioletti	2,500*
Cir. 87	Alfalfa, W. T. Clarke	20,000
Cir. 88	Advantages to the Breeder in Testing his Pure-Bred Cows for the Register of Merit, C. J. Hill	7,500
Cir. 89	Hog Cholera and its Prevention, C. M. Haring	7,500
Cir. 90	Tuberculosis in Cattle and Hogs, C. M. Haring	7,500
Cir. 91	Disinfection on the Farm, C. M. Haring	7,500
Cir. 92	Infectious Abortion and Sterility in Cows, C. M. Haring	7,500
Cir. 93	Bean Growing Contest, F. L. Griffin	2,500*
Cir. 94	The Dairyman's Relation to Quality, L. M. Davis	7,500
Cir. 95	Detecting Dairy Losses, L. M. Davis	7,500
Cir. 96	Pork Production, J. I. Thompson	7,500*
Cir. 97	Increasing Dairy Profits, H. E. Van Norman	7,500*
Cir. 98	Plowing and Cultivating Soils in California, C. B. Lipman	20,000
Cir. 99	Hatching and Rearing of Chicks, J. E. Dougherty	20,000
Cir. 100	Pruning Frosted Citrus Trees, J. E. Coit	16,000
Cir. 101	Codling Moth Control, C. W. Woodworth	20,000
Cir. 102	The Wooly Aphis, C. W. Woodworth	20,000
Cir. 103	Chemical Analyses of Waters	2,000*

There have been published by the University of California Press, under the heading UNIVERSITY OF CALIFORNIA PUBLICATIONS IN AGRICULTURAL SCIENCE, four Technical Bulletins, which were contributed by members of the staff of this department as follows:

Vol. 1. 1912 (In progress)
No. 1. The Distribution and Activities of Bacteria in Soils of the Arid Region, C. B. Lipman.
No. 2. Studies on the Phenoldisulphonic Acid Method for Determining Nitrates in Soils, C. B. Lipman and L. T. Sharp.
No. 3. The Effects of Calcium and Magnesium Carbonates on Some Biological Transformations of Nitrogen in Soils, W. P. Kelley.
No. 4. The Aluminum Reduction Method as Applied to the Determination of Nitrates in "Alkali" Soils, P. S. Burgess.

1,000 copies each of the technical bulletins have been published and are to be obtained by subscription. All bulletins and circulars of the Agricultural Experiment Station are, in accordance with the law, sent free of charge to any citizen of the State. During the year the mailing list of the Agricultural Experiment Station has been increased from about 12,000 to about 18,000 names. Approximately 405,000 bulletins and circulars have been distributed. In addition 20,000 copies of the Prospectus of the College of Agriculture have been printed and distributed. (University of California Bulletin, 3d Series, Vol. 6, No. 6). The first number of the "University of California Journal of Agriculture" was issued in May by the students of the College of Agriculture.

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* Edition exhausted.

PERSONNEL

The position of Principal of the University Farm School has been abolished and the position of Dean of the University Farm School and Vice-Director of the Agricultural Experiment Station has been created, thus placing the varied activities of the University Farm under a single management. There has been elected to this position Professor H. E. Van Norman, formerly Professor of Dairy Industry at the Pennsylvania State College, with the additional title of Professor of Dairy Management.

The position of Director of the Citrus Experiment Station and Dean of the Graduate School of Tropical Agriculture has been created. The activities of the Citrus Experiment Station and the Southern California Pathological Laboratory have been both placed under the direction of that office. To this position Dr. H. J. Webber, formerly Professor of Plant Breeding in Cornell University, has been elected, with the additional title of Professor of Plant Breeding.

The Division of Experimental Agronomy has been changed to the Division of Agronomy, to the headship of which Professor John W. Gilmore, formerly President of the College of Hawaii, has been elected with the title of Professor of Agronomy. Dr. G. W. Shaw, Associate Professor of Experimental Agronomy, having been granted leave of absence on January 1st, 1913, Mr. B. A. Madson, Instructor in Experimental Agronomy, was in charge of the division during the remainder of the year.

In addition to the offices, class-rooms, and laboratories of the division at Berkeley, this division carries on investigations and instruction at the University Farm at Davis, where forty acres of land are set aside for its use. This division has charge of the Experiment Station on the twenty-acre tract at the Kearney Ranch, and also of the Imperial Valley Farm of forty acres, located six miles east of El Centro. The investigations at this farm continue in the immediate charge of Mr. W. E. Packard as Agronomist in charge.

A definite division of Agricultural Chemistry has been created. Professor J. S. Burd has been elected Professor of Agricultural Chemistry. This division will have charge of conducting the analyses under the Fertilizer Control Act, in carrying on investigations, and giving instruction in Agricultural Chemistry. In order to give space for its activities in the Fertilizer Control Building, the State Food Laboratory, in charge of Professor M. E. Jaffa, has been transferred to the first floor of the old Entomology Building. This arrangement gives the Division of Nutrition, in charge of Professor Jaffa, additional space for its work in Budd Hall.

The work in Poultry Husbandry, which heretofore has been under the direction of the Division of Nutrition, has been made a separate division, with Assistant Professor J. E. Dougherty in charge.

A Division of Genetics has been created. Professor E. B. Babcock, formerly Assistant Professor of Agricultural Education, has been placed in charge as Professor of Genetics. The Division of Agricultural Education is continued in charge of Assistant Professor W. G. Hummel.

In the re-organization of the investigational work of Southern California, Professor R. E. Smith, who, during the past year, has been abroad on leave of absence, has been transferred to Berkeley and placed in charge of the Division of Plant Pathology.

During the absence of Professor Smith, Assistant Professor W. T. Horne has been in charge of the Division of Plant Pathology, including the Southern Pathological Laboratory. In the interim Mr. H. D. Young has handled executive affairs at the Laboratory.

Dr. J. Eliot Coit, who was Superintendent of the Citrus Experiment Station at Riverside, has been elected Professor of Citriculture in the new Division of Citriculture and transferred to Berkeley.

Assistant Professor Bonns has been temporarily in charge since January 1st.

The instruction and investigation in soils have been divided into two divisions—the Division of Soil Chemistry and Bacteriology and the Division of Soil Technology. To the Division of Soil Chemistry and Bacteriology, Dr. C. B. Lipman, formerly Associate Professor of Soils, has been elected Professor of Soils Chemistry and Bacteriology, and Professor Chas. F. Shaw, formerly Assistant Professor of Agronomy in the Pennsylvania State College, has been elected Professor of Soil Technology. In addition to its offices and laboratories at Berkeley the Division of Soil Chemistry and Bacteriology has been assigned land at the University Farm, Davis, on which to carry on research work, and will also conduct investigations at the Kearney Ranch, Fresno.

The Division of Soil Technology, in addition to its instructional work at the University at Berkeley, is the representative of the University in the drainage investigations which are being made in coöperation with the Office of Experiment Stations of the United States Department of Agriculture. This division is also engaged, in coöperation with the Bureau of Soils of the United States Department of Agriculture, in a soil survey of California. A reconnaissance soil survey will be conducted during the summer of 1913 in the Sacramento Valley.

Former Dean E. J. Wickson continues as Professor of Horticulture. The Divisions of Citriculture, Pomology, and Landscape Gardening and Floriculture have been created. Professor A. V. Stubenrauch, Pomologist and Horticulturist of the U. S. Department of Agriculture, has been elected to the Professorship of Pomology, although the date of his acceptance has not yet been determined. In the interim, Assistant Professor B. B. Pratt, formerly of the Bureau of Plant Industry of the United States Department of Agriculture, is in charge of the division. Professor John W. Gregg, formerly Assistant Professor of Landscape Gardening at the Pennsylvania State College, has been elected Professor of Landscape Gardening and Floriculture. This division is not only developing the work in landscape gardening and floriculture, but is especially charged with the responsibility of giving instruction in plant propagation to sophomores.

A definite Division of Agricultural Extension has been created. Professor W. T. Clarke, formerly Associate Professor of Horticulture and Superintendent of University Extension in Agriculture, has been placed in charge of this division as Professor of Agricultural Extension and Superintendent of Farmers' Institutes. Assistant Professor L. M. Davis has been placed in charge of the Division of Dairy Industry, and Professor Gordon H. True, formerly Director of the Nevada Experiment Station and Professor of Animal Husbandry at the University of Nevada, has been elected Professor of Animal Husbandry. Dr. C. M. Haring, Assistant Professor of Veterinary Science, has been made Professor of Veterinary Science.

Professor F. T. Bioletti, Associate Professor of Viticulture, has been made Professor of Viticulture and Enology; and Professor C. W. Woodworth, Professor of Economic Entomology, has been made Professor of Entomology. Mrs. D. L. Bunnell, formerly secretary to the Director, has been made Department Librarian, and Mr. David N. Morgan has been elected assistant to the Director.

Plans are under way for the organization of three additional divisions—Farm Mechanics, Rural Institutions, and Forestry. It is proposed to establish at the University Farm at Davis a Division of Farm Mechanics, which, in addition to giving instruction to both University students and University Farm School students, shall eventually establish a laboratory for the testing of farm machinery. It is believed that there is no place in the United States which offers better opportunity for the development of a laboratory of this character.

The Department of Rural Institutions has been created for the purpose of study, development, and guidance of those institutions which affect the open country. It will include certain features of rural life outside of farming operations which are of great importance but which have thus far been neglected.

The institution has had a pre-forestry course and there is already a body of enthusiastic students interested in forestry. The importance of forestry to California is too well known to need mention.

Mr. R. M. Roberts, Manager of the University Farm, resigned December 1st, 1912. Pending the arrival of Professor H. E. Van Norman, Dean of the University Farm School and Vice-Director of the Experiment Station, Mr. John I. Thompson, of the Division of Animal Husbandry, served as manager. The director is under personal obligations to Mr. Thompson for his efficient service. The Director has also been efficiently aided in the conduct of his office by Professor E. B. Babcock, who has, in the Director's absence, acted as Dean and Director, and otherwise greatly aided the office.

The Governor of the State has honored the College of Agriculture by appointing Professor E. J. Wickson to study the subject of Farm Credits in Europe.

BUILDINGS

Agriculture Hall.—The new Agriculture Hall was completed during the year at a cost, including equipment, of $200,000. Classes were held in the building for the first time during the first semester. The building was dedicated on November 20, 1912, by appropriate ceremonies, which are reported in the University of California Chronicle, Vol. XV, No. 1. During the exercises the bust of Dr. E. W. Hilgard, the first Director of the Agricultural Experiment Station, which was contributed by the students, the alumni, and Faculty of the College of Agriculture, was unveiled, and appropriate recognition of the esteem and affection in which retiring Dean Wickson is held was made by his faculty associates.

The new Agriculture Hall contains the Dean and Director's offices and Department Library, the Agricultural Museum, and the Divisions of Agricultural Extension, Citriculture, Entomology, Genetics, Landscape Gardening, Horticulture, Plant Pathology, Enology, Viticulture, and the Department of Irrigation. The old Agricultural Hall, with the name changed to Budd Hall, houses the Divisions of Agricultural Education, Agronomy, Nutrition, Soil Chemistry and Bacteriology, Soil Technology, and Veterinary Science. The Divisions of Animal Husbandry and Dairy Industry also carry on their work in this building so far as it is conducted at Berkeley.

Citrus Laboratory.—A new laboratory and residence building at the Citrus Experiment Station, Riverside, was completed during the year at a cost of about $15,000. The building has been equipped to the extent of furnishing the offices and fitting up a Physiological Laboratory. The upper floor has been assigned to agents of the Bureau of Plant Industry of the United States Department of Agriculture, who are carrying on investigations in Southern California. In connection with the reorganization of investigations in Southern California the legislature has appropriated $100,000 for the erection of a laboratory and $25,000 for a smaller building, including a residence for the Director of the Citrus Experiment Station.

Buildings at University Farm.—A second dormitory has been completed at the University Farm at a cost, including equipment, of about $38,000. This new dormitory has capacity for about sixty-five persons, giving the University Farm School a dormitory capacity of about one hundred and thirty. A building for poultry office, classroom, and laboratory work and a cottage for the farm foreman at a cost of about $10,000, and a building for experimental hog feeding and student work in swine judging at a cost of about $5,000 have been erected during the year. An additional appropriation of $40,000 has been made by the legislature for another dormitory; $10,000 has been provided to increase the dining room, $65,000 for a classroom building, and $20,000 for repairs and small structures. Out of this fund a building for farm machinery is being constructed and some changes are being made in the dairy building.

During the year a new well has been drilled to the depth of three hundred and sixty-nine feet and a new direct connected motor pump installed and covered with a temporary building. The pump has a capacity of 430 gallons per minute which the well supplies without diminution. Thus far the water has proved to be of excellent quality.

Greenhouses.—The greenhouses of the department have been assigned to the Division of Landscape Gardening and Floriculture, being used by that division in its instruction in plant propagation and floriculture. At present a number of other divisions are also accommodated in the greenhouses. Soil Chemistry and Bacteriology occupies one whole house, while Botany, Plant Breeding, and Plant Pathology occupy another. At present the greenhouse facilities are inadequate. Last semester fully half the students desiring work in floriculture had to be refused admittance because of lack of space. In the very near future the greenhouse space will be totally inadequate for the needs of the sophomore class in plant propagation. New greenhouses of modern type of construction suitable for research and student work should be constructed at once at a cost of not less than $20,000. These houses should be located on the University Campus in harmony with the agricultural group of buildings and should be made a part of the University's permanent plan.

According to the last census California ranks seventh in total area covered by greenhouse glass, having nearly 4,500,000 square feet. The State also ranks seventh in value of products, producing annually greenhouse stock to the value of $1,389,000. The people of California are rapidly demanding the superior quality of glass-grown stock. The great bulk of stock, bringing the highest prices in the best flower stores in the largest cities, is glass-grown. This means that there will be furnished as wide a field for research work here as is now found in Illinois or New Jersey, where much valuable work is being carried on in experimental floriculture.

New Unit for Agricultural Group.—The most serious need in the way of buildings for the Department of Agriculture is a new unit for the agricultural group to cost approximately $200,000. The splendid new Agriculture Hall is already overcrowded. The basement and attic rooms are now being used for purposes for which they were never intended. In the new unit for the agricultural group emphasis should be placed upon class rooms and laboratories. The space should be assigned about as follows:

1. Basement	Soil Technology and Soil Survey.
2. First Floor.	Agricultural Chemistry, Soil Chemistry and Bacteriology.
3. Second Floor.	Agronomy, Field Crop Investigations, Farm Management and Rural Institutions.
4. Attic.	Forestry.

This building should contain an auditorium to seat 300, and three class rooms to seat fifty each, suitably arranged in connection with the following series:

Basement.	Laboratory to accommodate 80 persons, office space for 5 persons.
First Floor.	Two laboratories to accommodate 50 persons each and office space for 10 persons.
Second Floor.	One laboratory and one class room to accommodate 50 persons each and office space for 10 persons.
Attic.	Laboratory for 80 persons and office space for 5 persons.

LAND

At Berkeley.—The space in Strawberry Canyon, north of Strawberry Creek and between the first north and south fence east of the Dairy Farm and a fence to be built at the foot of the west slope of Monument Hill, was, by vote of the Committee of Grounds and Buildings, assigned to the Department of Agriculture. It is planned to remove the Hog Serum plant from this canyon to a location possessing railroad trackage in order that animals and food can be handled more expeditiously and economically.

A portion of the space above mentioned is used for the Sanitary Dairy. It is planned to enlarge the elementary instruction in Dairying and Animal Husbandry to be given at Berkeley, including Bacteriology and Sanitary Milk Production.

The remainder of the area has been assigned to the Division of Veterinary Science, which has been conducting and will continue to conduct extensive investigations on the immunization of cattle from tuberculosis and on methods of testing cattle with tuberculin.

The area at the Center Street entrance has been used during the last semester by Professor Gregg in the course in Plant Propagation. Seventy-three gardens were planted and cared for by as many students. The interest in this work shown by the students was eminently satisfactory and the gardens made a very creditable showing.

A considerable area west of Agriculture Hall has been used for nursery practice in Plant Propagation, the object being to grow material that will furnish work for students in grafting, budding, layering, cutting, and pruning. There are now growing 6,750 specimens of nursery stock. In addition 5,000 apricot and peach pits have been sown.

The area extending northward from the pathway from Agriculture Hall to University avenue and westward from Agriculture Hall to Oxford street has been used for experimental field cultures of tobacco, potatoes and walnuts and for small plots of alfalfa, cabbage, dasheen, beans, teparies, peas, corn, kafir, milo, melons, sudan grass and sunflowers. The small plots were mainly for purposes of class instruction. The tobacco plantation consists of hybrid plants resulting from an extensive investigation of inheritance in tobacco. The potatoes were partly tuber-unit selection experiments and partly variety tests. The walnuts are mostly supposed first generation hybrids between the California black walnut and certain native oaks. Seventy of these are five years old and are bearing their first crop of nuts while thirty-six are only two years old. There are about sixty other seedlings which have been grown for investigational purposes.

The Imperial Valley Farm.—This tract consists of forty acres. Ten acres were deeded to the Regents during the fiscal year by the supervisors of Imperial County. Two ten-acre tracts have been previously given to the University, one by the supervisors of Imperial County and the other by individuals in the vicinity of the farm. It is understood that the fourth and last ten acres will be contributed by the supervisors of Imperial County during the coming fiscal year. The land is to revert to Imperial County in case it is given up for experimental purposes.

The University Farm, which was purchased in accordance with a California Statute of 1905, comprises 779 acres situated at Davis, Yolo County. The farm is provided with buildings for instruction in practical agriculture and horticulture, including a commercial creamery, stock pavilion, horticultural building, cereal building, mechanical shops, buildings for horses, cattle, sheep, swine and poultry, two dormitories and a dining hall. Instruction is given at the University Farm to University students, University Farm School students and to short course students. Several divisions carry on extensive investigations, notably agronomy, animal husbandry, dairy industry, irrigation, and poultry husbandry.

Kearney Park—The Kearney Estate, which was bequeathed to the University of California by M. Theodore Kearney, comprises 5,400 acres on which are situated extensive vineyards, orchards, and alfalfa ranches. A tract of twenty acres on this ranch has been set aside for experimental purposes, otherwise it is managed chiefly as a commercial enterprise.

Other Lands.—The University owns three acres at Riverside and has a twenty-year lease on twenty acres adjoining, about sixteen of which are under irrigation. On eight acres of the leased area a citrus fertilizer experiment was started in 1907. There are twenty plats. Each plat contains twenty-four trees, six each of the following varieties: Eureka and Lisbon lemons, Navel and Valencia oranges. A city lot, 100 by 300 feet, on which the Southern Pathological Laboratory is located, is owned at Whittier. Two tracts of 20 and 30 acres are owned at Santa Monica and Chico respectively, on which forest plantations have been established.

New Land for Citrus Experiment Station.—The legislature has appropriated $60,000 for land on which to locate the Citrus Experiment Station and the Graduate School of Tropical Agriculture.

General Location.—In general the work is to be on tropical and sub-tropical plants such as citrus fruits, walnuts, olives, avocados and the like. A warm location as nearly free from frost as possible and one which is suitable to the commercial cultivation of these plants is needed.

Nearness to City.—The station should be located near a city of some size and where it is easily accessible to railway, street car, telephone, and telegraph service. It would be very desirable to have it near enough the city to be connected with city water, gas and electricity, if this is possible.

It is hoped that men, eminent in their specialties, may be attracted to this station and school and such men will not come to an isolated station. Accessibility to good schools, churches, modern city conveniences, good home associations and the like are important factors both from the standpoint of faculty and students.

Amount of Land.—It is estimated that there will be required immediately a tract of about 200 acres, all of which must be fairly good to first-class land. If certain parts of the land are not suitable for cultivation a larger acreage will be necessary. It is impossible to estimate at this time how much land will be required ultimately for such an institution, which is likely to increase in size and importance and it is desirable, if possible, to locate the station where more land of suitable quality may later be obtained if found necessary.

Kind and Quality of Land Desired.—The land, as stated above, should be good land suitable to the cultivation of oranges, lemons, avocados, walnuts, olives and the like. It should be as warm and free from frost as possible. Unimproved land not planted in grove is much to be preferred, as in the majority of cases lemon or orange groves already on a place would be valueless for the experiments contemplated. A small acreage of orange or lemon grove on the tract would not be particularly objectionable. It is of importance to have available an abundant water supply as for experimental purposes no failure of water should be possible. As years go by the experiments, if properly managed, will become immensely valuable to the State and must be protected with plenty of water.

COÖPERATION

Irrigation.—Irrigation investigations, which were started in 1907 in coöperation with the Office of Experiment Stations of the United States Department of Agriculture, have been continued during the past year as usual. These investigations are under the general supervision of Mr. Frank Adams, irrigation manager of the Office of Experiment Stations, with Mr. S. H. Beckett in immediate charge. Extensive investigations have been made upon the duty of water under conditions existing at the University Farm. A summary of these experiments is now being published by the United States Department of Agriculture.

The first three years of coöperative irrigation investigations on the University Farm were largely devoted to preparing the field for irrigation by different methods, building structures, studies of seepage losses in experimental trenches lined with different materials, tank experiments in the water requirements of crops, studies of evaporation losses, and the preliminary growing of alfalfa as a preparatory crop. Since 1910 the investigations have mainly had to do with a determination of the water requirements of alfalfa, but experiments designed to determine the value of irrigating grain and corn have also been carried on, a field laboratory for testing and demonstrating the use of standard irrigation measuring devices has been in process of development, a beginning has been made in a series of experiments in rotating under irrigation such standard field crops as alfalfa, sugar beets, potatoes, grains, and corn, and an experimental orchard and an experimental vineyard have been set out on which the various standard methods of orchard and vineyard irrigation will be tested and shown.

In studying the water requirements of alfalfa usual field practise has been followed, the crop being grown on rectangular and border checks of standard field size and irrigated by ordinary check flooding. The seasonal depths of water applied have been 12, 18, 24, 30, 36, and 48 inches, and the average yields have been, respectively, 6.26, 7.02, 7.56, 8.85, 8.75, and 8.97 tons per acre, with an average of 5.13 tons per acre on the check plats not irrigated, each field yielding six cuttings.

In other words, alfalfa yields have steadily increased with seasonal applications of water up to 30 inches, but with applications above 30 inches the increases have been negligible.

Conclusive as these results seem to be, the experiments are being continued and are being checked by measurements being made by the Office of Experiment Stations on about fifty farms at Dixon, Woodland, Orland, Los Molinos, and Gridley. Soil moisture determinations are being made both before and after each irrigation on all of the alfalfa plats at Davis and on the outside fields wherever means will permit, and with the data thus obtained more exact information as to the duty of water for alfalfa on the various soils considered will be obtained than has heretofore been available.

Experiments in grain and corn irrigation have in each case shown increased profits from the use of water. After deducting the cost of irrigating this increase has varied from $8 to $12 per acre in the case of grain given two light irrigations and from $1.40 to $5.40 per acre in the case of corn similarly watered. Grain plats irrigated immediately after harvest and then seeded to cow peas, which were later turned under, have shown grain yields the following seasons, with only single early irrigations of the grain, varying in value from $11 to $17 per acre above the value of the yields from the unirrigated fields.

Drainage.—An agreement has also been entered into with the Office of Experiment Stations to place in this State, in coöperation with the California Agricultural Experiment Station, a drainage expert who shall make a careful study of drainage conditions in California. Already experiments are under way, in coöperation with the Office of Experiment Stations and the management of the Kearney Ranch, for the drainage of one hundred and sixty acres of land which has, during the past ten years, become affected with alkali. During the month of June, Mr. R. A. Hart, the Western field agent for drainage investigations of the Office of Experiment Stations, made a careful study of this area assisted by Professor Charles F. Shaw and Mr. F. H. Wilson, of the Division of Soil Technology, together with eight students in Soils.

Seed Testing.—A coöperative branch Seed Laboratory of the United States Department of Agriculture was established in Budd Hall on October 5, 1912, in connection with the Division of Agronomy, with Miss Anna M. Lute of the United States Department of Agriculture in charge. During the fiscal year eleven hundred samples were received and tested, the samples coming principally from farmers and seedsmen.

Soil Surveys.—The California Agricultural Experiment Station has entered into a coöperative agreement with the Bureau of Soils, United States Department of Agriculture, for the purpose of completing a soil survey of the State of California. The soil survey work will be of two general characters—a reconnaissance survey of large areas on a scale of four to six miles to the inch, and a detail survey of counties on a scale of one mile to the inch.

Agricultural Advisors.—The College of Agriculture, through its Division of Agricultural Extension, has entered into coöperation with the Division of Farm Management, Bureau of Plant Industry of the United States Department of Agriculture. A state leader, Mr. B. H. Crocheron, has been elected Assistant Professor of Agricultural Extension with the view of organizing agricultural advisers throughout the State.

Bureau of Plant Industry.—Laboratory facilities have been given in the laboratory of the Citrus Experiment Station, Riverside, to agents of the Bureau of Plant Industry, United States Department of Agriculture, for investigations of certain soil problems in connection with citrus fruits; and office space has been given to Mr. A. D. Shamel and his assistant, Mr. Scott, who are conducting extensive investigations for the Bureau of Plant Industry on the subject of bud variations.

Delta Investigations.—The coöperative arrangement with the Bureau of Plant Industry of the United States Department of Agriculture and the Delta Association, by which field experiments have been conducted at Middle River Station on the lands of the Rindge Land and Navigation Company, has been somewhat modified. During the first season the investigations outlined by the Agricultural Experiment Station were in direct charge of Mr. Roy M. Filcher, employed by the Company. Fertilizer experiments were conducted with barley, and various trials with beans, vetches, field peas, cow peas, soy beans, and corn were made. At the same time, on a near-by area, potato investigations were conducted by the representative of the Bureau of Plant Industry, Mr. J. P. Irish. Mr. Irish having withdrawn, Mr. W. V. Shear being assigned as the bureau's representative, will hereafter have immediate supervision of all investigations, reporting in duplicate the results of these investigations both to the Bureau of Plant Industry and to the California Agricultural Experiment Station, whether outlined by the Bureau of Plant Industry or by the Division of Agronomy of the Agricultural Experiment Station.

Lima Beans.—Work on the improvement of lima beans was carried on at Oxnard in coöperation with the Lima Bean Growers' Association, for which purpose one hundred dollars was contributed by the Association. A bulletin, No. 238, "The Selective Improvement of the Lima Bean," by Dr. G. W. Shaw, has been published as the result of these investigations.

Infantile Paralysis.—An investigation was completed during the year to determine whether the stable fly (Stomoxys calcitrans) was a factor in transmitting infantile paralysis (Poliomyelitis). The investigation was carried on by W. B. Herms, Assistant Professor of Parasitology in this department, in conjunction with Dr. W. A. Sawyer, Director of the Hygienic Laboratory of the State Board of Health. To carry on this investigation the sum of $500 was set aside by the Experiment Station and a like sum contributed by the State Board of Health. With this amount it was possible to secure satisfactory equipment in cages, monkeys, rodents, and assistance to conduct the investigation, which began about November 1st and ended July 1st, 1913, covering a period of about eight months of continuous observation. A report of this investigation has been published in "The Journal of the American Medical Association." A summary of the conclusions of this investigation follows:

"In a series of seven experiments in which the conditions were varied, we were unable to transmit poliomyelitis from monkey to monkey through the agency of the stable fly.

Further experiment may reveal conditions under which the stable fly can readily transfer poliomyelitis, but the negative results of our work and of the second set of experiments of Anderson and Frost lead us to doubt that the fly is the usual agent in spreading the disease in nature.

It is the opinion of the majority of investigators who have worked with this disease that the infection is carried by healthy persons who have been in contact with the sick, and by convalescents. Therefore we should continue to isolate persons sick with poliomyelitis or convalescent, and we should attempt to limit the formation of human carriers and to detect and control them.

Screening of sick rooms against the stable fly and other flying insects is a precaution which should be added to those directed against contact infection, but not substituted for them.

The measures used in suppressing the house fly are not applicable to the control of the stable fly owing to its different breeding habits and food supply. Methods should be devised for diminishing the numbers of stable flies as they are a great annoyance to cattle and, in all probability, are capable of transferring and inoculating a number of the diseases of animals."

Certified Milk Commissions.—An arrangement has been made by which the expert work of the Alameda County Medical Milk Commission and the San Francisco Medical Milk Commission will be conducted by the Veterinary Division of this department with Dr. C. L. Roadhouse in immediate charge. Compensation for this work is paid to the Regents of the University on bills rendered by this department.

Cow Testing Associations.—There are at present in the State four active Cow Testing Associations. The dairy division assisted in the organization of three in coöperation with the Federal Dairymen. The value of community work of this nature is realized more after it is taken up and followed regularly. One California association is now testing 2600 cows and there are two men supervising the work. Bulletin 233 is a report on this work.

The Educational Butter Scoring Contest is now in its fifth year, and is participated in by over ten per cent of the creameries in the State. This is a bi-monthly contest which is self-supporting. At each scoring the butter is examined for quality, is tested for moisture and salt, and a complete report together with a letter of criticism sent to individual contestants. In November, 1912, four prize cups and seven certificates of merit were awarded.

WINNERS OF PRIZE CUPS

1st—Victor Baciarini, Suisin, Cal.
2nd—H. Ostergard, Greenview, Cal.
3rd—Hans L. Beck, Fresno, Cal.
4th—Peter Petersen, Loleta, Cal.

CERTIFICATES OF MERIT

Victor Baciarini, Suisuin, Cal.
H. Ostergard, Greenview, Cal.
Hans L. Beck, Fresno, Cal.
Peter Peterson, Loleta, Cal.
J. L. McDowell, Tulare, Cal.
Arnold Madsen, Salinas, Cal.
P. M. Becker, Grizzly Bluff, Cal.

The Dairy Division of the United States Department of Agriculture has coöperated heartily in this and other work of the Dairy Division of this Station.

OFFICIAL TESTING OF PURE BRED COWS

The Station has continued to coöperate with the different cattle clubs and associations in testing registered pure bred cows for authenticated records of their production. The best four official 7-day records made in California during the past year are as follows:

	Age		lbs. milk	Containing lbs. fat	Owner
Holstein-Friesian,	12½ yrs.	Aralia de Kol (world's record for age)	724.4	24.108	A. M. Morris & Sons, Woodland
Holstein-Friesian,	8 yrs.	Riverside Sadie De Kol Burke (world's milk record)	902.1	25.834	A. W. Morris & Sons, Woodland
Holstein-Freisian,	6½ yrs.	Helena Juliana Burke of Riverside	536.8	21.257	B. F. Anderson, Modesto
Holstein-Freisian,	7 yrs.	Edith Madel Wayne	482.3	23.249	L. A. Hall & Bro., San Jose
Holstein-Friesian,	3½ yrs.	Tilly Alcarta	21,421.3	672.98	A. W. Morris & Sons, Woodland

The following list of breeders with the number of animals on test is given below.

Guernseys, 6 cows on year test:

J. W. Henderson, Berkeley, Cal.	3
Chas. G. Lathrop, Stanford University, Cal.	3

Jerseys, 73 cows on year test:

L. J. Belknap, San Jose, Cal.	7
W. A. Bradley, Turlock, Cal.	7
D. F. Conant, Modesto, Cal	8
F. M. Dimoch, Turlock, Cal.	3
L. J. Dobler, Turlock, Cal.	4
J. A. Goodall, Keyes, Cal.	1
W. J. Hackett, Ceres, Cal.	7
C. D. Hayworth, Modesto, Cal.	4
G. O. Hilliar, Modesto, Cal.	12
G. F. Kendall, Hughson, Cal.	1
G. H. Miller, Modesto, Cal.	5
University Farm, Davis, Cal.	1
J. F. Snover, Ceres, Cal.	7
S. B. Wright, Santa Rosa, Cal.	4
C. N. Odell, Modesto, Cal.	2

Holstein-Friesians, 67 cows on year test, 10 30-day and 140 7-day tests:

K. W. Abbott, Milpitas, Cal.	5	7-day
B. F. Anderson, Modesto, Cal.	2	7-day
H. E. Cornwell, Modesto, Cal.	5	7-day
L. A. Hall & Bro., San Jose, Cal.	5	7-day & 4 30-day
J. H. Harland Company, Woodland, Cal.	4	7-day & 2 30-day
M. Holdridge, Modesto, Cal.	4	7-day
M. A. Maclean, Modesto, Cal.	5	7-day
Merci Ranch (H. L. Morton), Modesto, Cal.	5	7-day
A. W. Morris & Sons Corp., Woodland, Cal.	86	7-day & 4 30-day 64 on year test
University Farm, Davis, Cal.	3	on year tests
University of Nevada, Reno, Nev.	1	7-day
Leland Stanford Jr. University (Vina Ranch) Vina, Cal.	13	7-day
H. L. Weston, North San Diego, Cal.	5	7-day

UNIVERSITY OF CALIFORNIA CERTIFIED DAIRY

During the year, the University Dairy at Berkeley has been conducted with a view of emphasizing sanitary milk production to students and others. To improve the quality of the product, a considerable number of minor improvements have been made and a number of pieces of improved apparatus have been installed. This dairy herd now numbers thirty-two head of cows, seven yearling heifers and five calves. During the year the income from sale of products from 24 milking cows was: milk, $8,605.69; skim-milk, $238.85 and cream,

$968.60; making a total of $9,812.06. The average gross income per cow from sale of products for the year, including six dry cows, was $306.62. In addition 6,300 pounds of University Farm butter were distributed, which sold for $2,523.00, or an average of approximately 40 cents per pound.

The average butter fat content of certified products was: milk, 4.03 per cent; skim-milk, 0.11 per cent, and cream, 32.50 per cent.

The number of bacteria per cc. was determined semi-monthly with the following average result: milk, 3,659; skim-milk, 3,970, and cream, 6,707. The Medical Milk Commission allows: milk, 10,000; skim-milk, 10,000, and cream, 30,000.

UNIVERSITY FARM CREAMERY

For the year ending June 30, 1913, there were made at the University Farm Creamery 161,429 pounds of butter, 840 pounds of cheese and 692 gallons of ice cream. The increase in the amount of products handled is indicated by the pounds of butter fat received for each year ending June 30, as stated below:

1911	95,621
1912	121,548
1913	128,134

The total sales of dairy products were $56,235.79.

FERTILIZER CONTROL

During the fiscal year ending June 30, 1913, 650 fertilizers were analyzed, classified as follows:

20 samples	for consumers in return for a nominal fee.
139 samples	for consumers free of all charges.
50 samples	on so-called "Station Analysis," such analysis to be used as a basis of settlement between buyer and seller.
335 samples	found on sale in hands of dealers.
106 samples	of miscellaneous materials sent in for examination.

The number of samples has been purposely kept as low as possible and still be sufficiently great to permit of judgment as to the extent to which manufacturers of fertilizers are complying with the spirit of the Fertilizer Act. The detailed results included in the annual bulletin on Commercial Fertilizers (No. 240), show that only 31 samples were of less commercial value than guaranteed by the manufacturer, indicating that the consumer of fertilizers is receiving the protection contemplated by the Fertilizer Act.

During the year Professor Burd has made a considerable study of the fertilizer laws of the various states and suggested to the legislature certain amendments to the Fertilizer Act designed to promote its efficiency. These amendments failed to become law, but it is hoped that the work done in this connection may be used to advantage at a subsequent time.

INSECTICIDE CONTROL

No case requiring prosecution has arisen during the year. There were numerous violations of the law, but in every case when attention was called to the fact steps were immediately taken to rectify the fault.

The insecticide inspection required the work of seven inspectors, who traveled by rail, stage and boat approximately 9672 miles, visiting 332 towns and rendered detailed reports on the insecticides stocked by 1631 dealers of whom 984 were operating under licences issued by the University, the balance handling only registered goods in original packages. The number of brands registered and labels inspected was 9646, the number of samples taken up was 777 and of analyses made was 553.

The insecticide control law was amended in several important particulars at the last session of the legislature. No fee nor registration is required under the law as amended. The use of labels indicating registration is, therefore, not necessary. An annual inspection is no longer required and changes were made in the method of sampling.

Grocers and general dealers have been exempted from the operation of the law for certain articles. Druggists have been exempted for United States Pharmacopaoia or National formulary preparations as well as medical and toilet articles registered under the pure food and drugs act. Circular No. 104 of this Station gives the new law in full.

THE ANTI-HOG CHOLERA SERUM LABORATORY

During the year this laboratory has distributed 1,350,235 cc. of serum and 17,528 cc. of virus, which have been used to immunize approximately 52,300 head of hogs.

The Legislature of 1911 appropriated $16,000 to establish the hog serum laboratory and provide for the distribution of serum at actual cost of production. The law also provided for the distribution of 500 cc. free of cost to hog raisers whose hogs were infected or in immediate danger from cholera. This provision covered the two years beginning July 1, 1911, and ending June 30, 1913.

The following tables cover the work of the laboratory during the above mentioned biennial period:

RESULTS OF THE USE OF ANTI-HOG CHOLERA SERUM, JULY 1, 1911, TO JUNE 30, 1913

Total number of hog owners that applied for the serum	528
Total number of hogs treated	72,750
Total number of hogs showing no visible symptoms at time of injection	67,257
Per cent that lived showing no visible symptoms at time of injection	95.3%
Per cent that died showing no visible symptoms at time of injection	4.7%
Total number showing visible symptoms of cholera at time injected	5.492
Per cent that lived showing visible symptoms of cholera at time injected	36.1%
Per cent that died showing visible symptoms of cholera at time injected	63.9%

Hog cholera was epidemic in the immediate vicinity of 98.2% and actually present on 96.6% of all the ranches on which our serum was used. A low estimate of the average number of deaths from cholera in communities where cholera is prevalent is fifty per cent of all hogs.

Signed reports, giving the results of the use of serum on 28,154 hogs have been received from 254 of the 528 hog owners. The above estimates were computed from these reports.

Number cc. of serum reported used, that were sold from July 1, 1911, to July 1, 1912	369,241 cc.
Number cc. of serum given free from July 1, 1911, to July 1, 1912	100,745 cc.
Total cc. of serum reported used from July 1, 1911, to July 1, 1912	469,986 cc.
Number cc. laboratory virus reported used from July 1, 1911 to July 1, 1912	1,159 cc.
Number cc. of serum reported used that were sold from July 1, 1912, to July 1, 1913	1,207,795 cc.
Number cc. of serum given free from July 1, 1912, to July 1, 1913	142,440 cc.
Total cc. of serum reported used from July 1, 1912, to July 1, 1913	1,350,235 cc.
Number cc. of laboratory virus reported used from July 1, 1912, to July 1, 1913	17,528 cc.
Total cc. of serum and virus reported used in two years ending July 1, 1913	1,838,908 cc.
Percentage of free serum to the total amount reported used	13.3%

Total number of hogs treated July 1, 1911, to July 1, 1912	20,450
Average dose of serum	23 cc.
Total number of hogs treated July 1, 1912, to July 1, 1913	52,300
Average dose	25.8 cc.
Total number of hogs treated during two years ending July 1, 1913	72,750

A conservative estimate of the number of hogs saved by the Anti-Hog Cholera serum is 30,000 head. The cost of the serum to farmers, in addition to that distributed free as provided by law, has been about

$33,000. Estimating the average value of a hog in California at $9.20 (taken from the February, 1913, Crop Reporter of the United States Department of Agriculture), the protection provided these 30,000 hogs has meant a saving to the ranchers of at least $240,000. This does not include the profits resulting from the breeding and profitable feeding of the hogs saved.

If in all cases the serum had been used as the Station recommends, that is, before the disease had gained entrance to the herds, then 99 per cent of all the hogs owned by these farmers would probably have lived, instead of only 50 per cent of the untreated hogs, and 91.3 per cent of the treated. That is, about $350,000 would have been saved in addition to the $240,000 mentioned above.

The following table shows the comparative success of the serum on infected and non-infected ranches:

	Hogs not exposed	Hogs exposed
Number of applications*	26	766
Number of well hogs treated	2,624	23,685
Number well hogs saved	2,604	22,458
Percentage well hogs saved	99.2	94.8
Number sick hogs treated	0	1,845
Percentage sick hogs saved	....	36.1
Number sick hogs saved	....	668

* These applications were from 528 ranches. In many cases several applications were received from the same ranch.

In considering the above table it should be noted that the hogs reported as not exposed were usually in sections where cholera was epidemic and probably became exposed subsequent to the use of the serum.

The results of the different methods of treatment recommended by the Agricultural Experiment Station are shown in the table below. It should be remembered that the serum alone treatment is recommended only when an immunity lasting for three weeks or less is desired.

	Serum alone	Serum & virus	Double method
Number applications	733	57	2
Number exposed well	13,667	10,018	169
Number unexposed well	1,174	1,450	1
Total treated	16,686	11,468	170
Sick treated	1,845	....	......
Well saved	13,818	11,244	170
Percentage well saved	93.1	98	100
Sick saved	668	....	......
Percentage sick saved	36.1	....	......

The relative degree of exposure was greater for the hogs treated by the "Serum Alone" method than those treated by the other two methods. For this reason the percentage of well hogs saved is less in the serum alone column.

There have been several cases in which the owners were not satisfied with the use of the serum. The following table shows these results arranged according to causes.

UNSATISFACTORY RESULTS FOLLOWING SERUM TREATMENT

	No. of applications	No. dead before treatment	Type of cholera	No. well treated	No. well saved	Percent well saved	No. sick treated	No. sick saved	Percent saved sick
Use of serum on sick hogs......	24	1,259	A. & C.	2,096	1,400	66.8	311	22	7
Use of serum alone when serum & virus should have been used ..	6	3		293	165	56.3	0	....	..
Use of serum & virus when serum alone should have been used	4	281	A. & C.	282	212	75.1	54	0	0
Spoiled serum & dirty methods of injection..	2	42	A.	163	?	?	75	3	4
Incorrect diagnosis	1	15		402	229	56.9	15	0	0
Totals........	37	1,600		3,236	2,006	61.9	455	25	7

The largest of these herds was one of pure-breds that the owner claimed was well and non-exposed. Later, when some of the hogs died, the feeder said that two large hogs had died during the previous two months under conditions that would suggest chronic cholera.

One of these applications was filed in September, 1911. The serum, however, was not used until January, 1912. During this interval the serum was kept on the ranch premises under unfavorable conditions without ice. The other case was that of a man who said he used three lots of serum, one from a private firm and two from this Agricultural Experiment Station. Several weeks afterward he reported bad results, which he believed attributable to spoiled serum in one of the lots from this Station. All other shipments from the mixtures from which these two lots of serum were taken gave satisfactory results; therefore, it seems doubtful whether the poor results reported were due to serum received from us.

The percentage of hogs on infected ranches that live when no serum is used is about fifty. Therefore, even in these unsatisfactory cases the farmers as a whole saved money by using the serum.

NOTE.—In the above table, A. means Acute and C. Chronic.

The following explanation of the preceding table should be taken into consideration:

Use of Serum Alone on Sick Hogs.—The use of serum on sick hogs is not recommended. The results of the injection of 1,845 sick hogs show a recovery of only 36.1 per cent. This is more than enough to pay for the serum used, but it should be remembered that some of these were not visibly sick, only showing the presence of the disease by a fever. In nearly all herds where visibly sick hogs are present many of the infected, but apparently well, hogs have fevers, so that a man who treats such a herd treats many more sick animals than is evident. The bad results in this column are largely due to this fact.

Use of Serum Alone where Serum and Virus should have been Used.—The immunity produced by the injection of serum alone lasts only from three weeks to six months, depending on the size of the animal and subsequent exposure to cholera. Unsatisfactory results may be expected in hogs treated by this method unless they are marketed within this period. An exception to this is in the case of hogs already infected and saved by a large dose of serum alone. Such hogs are immune for at least a year. All hog owners are urged to use the serum and virus simultaneous method, provided a competent operator can be secured.

Use of the Serum and Virus method when Serum Alone should have been Used.—The injection of virus into a hog, already sick, is liable to hasten its death. We have instructed all who use the serum that *the best way to determine whether a hog is infected is to take the rectal temperature with a clinical thermometer.* No hog having a temperature over 104.5° F. should be given the serum and virus treatment. Hogs having a chronic type of cholera at times show no fever, but such cases can often be detected on sight by an experienced man. Treatment of such animals by the serum and virus method usually brings on an acute attack of cholera.

Use of Spoiled Serum and Dirty Methods of Injection.—When the serum leaves the laboratory's ice-box it is in good condition, but if kept for a long time at a warm temperature, or in the sun it may spoil. This is probably what happened in one of the cases mentioned above, where the party kept serum from September to January before using. The other case mentioned is fully explained in the note following the table. Hogs just out of an irrigated field and hogs that are wet and dirty from any cause are hard to handle and infection of the needle hole is liable to result if they are treated while in this condition.

Incorrect Diagnosis.—Anti-Cholera Serum is a preventive for hog cholera only. Therefore, treatment of hogs for other diseases with it is useless.

CITRUS EXPERIMENT STATION

A complete re-organization of the work of investigation which has been conducted at the Southern California Pathological Laboratory, Whittier, and at the Citrus Experiment Station, Riverside, is contemplated.

The Legislature has appropriated $60,000 for the purchase of lands for the Citrus Experiment Station and $125,000 for buildings.

The following is an outline of the investigations as proposed by Dr. Webber:

Citrus Investigations.—The dominant industry of Southern California is the growing of citrus fruits and the primary problem of investigation will naturally be concerned with this industry. The studies that have been made by investigators of the University and of the National Department of Agriculture have given considerable information of value on certain problems, mainly in the treatment of diseases and in the handling and shipping of fruits, but even here much yet remains to be done. The excellent work that has been done by Professor Ralph Smith on lemon rot and by Mr. G. Harold Powell and his assistants in the Department of Agriculture on transportation problems, needs to be duplicated on many other problems of equal importance to the industry.

Citrus Diseases.—Probably the most serious disease affecting citrus fruits in California is that which is generally known as "mottle leaf." In many instances groves fail at a comparatively early age and such failure is usually accompanied by a mottling or frenching of the leaves, this being the most apparent symptom of the disease. Recently Mr. E. E. Thomas, one of the agents of the University, has studied a nematode worm which has been found infesting the roots of many such trees and in such numbers as to suggest that they may be the primary cause of the trouble, at least in some cases. Ordinarily it has been supposed that the failure was due to mal-nutrition or possibly to a combination of improper nutrition, irrigation and cultivation. The disease is of obscure nature and its importance is such that it is planned to conduct a thorough investigation from all points of view to determine, if possible, the true cause or causes of the malady. It is known that mottling or frenching is a symptom of a number of diseases being one of the first indications of the Florida dieback, and also, in some cases, one of the first symptoms of starvation. It may thus be that the California mottle leaf is due to different causes in different cases, although the general similarity of its appearance and progress would indicate a common cause in most cases. The influence of the nematode worm will be thoroughly studied along with other possible causes.

It is also intended to push the investigation of other diseases such as foot-rot, scaly bark and various fruit rots as rapidly as the conditions will permit.

Fertilizer Experiments.—The health of a plant depends in large measure on its treatment. An organism that is well treated and in perfect health is much less susceptible to disease than one weakened physically by poor treatment either of fertilization, cultivation, or pruning, or by poorly adapted soil or climatic conditions. It is thus highly important that the best methods of fertilization, cultivation and pruning be determined for the various citrus regions of the State. While growers have been fertilizing and manuring citrus trees for many years, no very definite information exists as to the best natural elements to use or the proper proportion of mixture. Probably more questions are asked regarding fertilization than any other factor of the industry and little definite information can be given. The experiments that have been conducted have not been carried on long enough to give reliable information. In order to obtain some reliable information on this important subject it is planned to start a series of comprehensive fertilizer experiments that will be conducted by the University during the life of the trees. Such experiments require to be very carefully planned and executed, and in outlining the tests it is intended to seek the advice of the best authoritites in the country. Many such experiments have been started and carried on for a number of years before it was discovered that errors in the plan prevented the deduction of general conclusions. It is hoped that these experiments may be so carefully planned as to ultimately solve some of the important problems. In a perennial crop, like all citrus fruits, it is of the highest importance that carefully planned experiments be conducted for a long series of years under the same treatment. Indeed, the most instructive fertilizer experiments, even with annual crops, are invariably those that are conducted for the longest period. It is also important that all sources of heritable variation in yield be avoided as far as is possible so that the differences in yield obtained in the experiments may be known to be caused primarily by the treatments given. In starting this experiment, therefore, all stocks used for a certain lot of comparative tests are to be grown from seeds of the same selected tree. Seeds were secured last spring from such selected trees and seedlings are now being grown to furnish stocks for this experiment. To eliminate sources of error due to variation in the type and productivity of different buds, it is also planned to take all of the buds for a certain comparative test from the same selected tree. Even after using the most careful methods known to secure uniformity in the stocks and buds used in growing trees for comparative experimental plats, there is nevertheless considerable variation in the heritable characters of the different trees and this element of error can only be overcome by the use of comparatively large numbers of trees and plats.

Methods of Cultivation and Irrigation.—Much difference of opinion exists regarding the methods of cultivation and irrigation and their effect on the tree and soil, and here, as in the case of fertilization, careful experimental data is much needed. It is expected to start experiments on problems of this nature as soon as the proper facilities have been secured. What has been said above in regard to the necessity of carefully planned long-time experiments with fertilizers applies equally well in the case of experiments in cultivation and irrigation.

Experiments with Varieties and Stocks.—The question of varieties is always an interesting one to growers and is never settled. The tests that have been made of the various varieties of oranges, lemons, and pomelos have been disconnected and usually on different soils and under different treatment. It is highly desirable that somewhere in California there be brought together as complete a set of the various varieties of citrus fruits as it is possible to obtain. So far as can be learned many good varieties exist that have never been tested in the State. One of the features of the Citrus Station grove will be a variety orchard where it is planned to have growing ultimately the largest number of citrus varieties to be found anywhere in the world. All foreign varieties should be imported and tested under our conditions and this, it is expected, will be one of the features of the work. While the Washington navel and the Valencia may be the best varieties of oranges to grow, a country that grows the most oranges of any in the world should know that they have the best sorts.

In attacking the problems of citrus culture no important factor should be neglected and it is thus planned to make comparative tests of the various stocks ordinarily used. Such an experiment to be effective must include a test of each important variety on each stock. The question of stocks has been much neglected and here, as in the case of varieties, it is by no means certain that the best sort are being used. Again it may be possible to breed a stock especially for California conditions that will be superior to any of the types now used. It is planned to make a thorough investigation of the whole stock question.

Pruning Experiments.—Closely connected with the tests of varieties and stocks is the question of pruning, on which again there is great difference of opinion and little definite knowledge, it is expected ultimately to inaugurate a series of pruning experiments that will give some definite knowledge as to the best methods to pursue with different varieties and demonstrate whether the different methods of pruning a certain variety gives similar results when on different stock.

Improvement of Varieties.—The grape fruit in California is in demand and sells at a good price, but it is not the high class fruit that is demanded to insure the superiority of the California product. The varieties grown are all of Florida origin selected for Florida conditions. We should have thin skinned, nearly seedless varieties of high flavor and what is demanded can probably be obtained only by breeding and selecting the variety in California to insure thorough adaptability.

The tangerine in California bears very heavily and is a large sized, very hardy tree. The quality of the fruits is exceptional but they are of such small size as to be in many cases unsaleable. A large fruited tangerine of the California quality would be much in demand. This should be easily produced.

The far-famed California navels are exceptional fruits, but it has been found that many trees produce very light crops regularly, while others produce fruits of different types. The variety is very prone to form bud sports of abberant forms, many of them worthless. In taking buds for propagating, up to the present time little attention has been given to this factor and many trees of poor types have thus been propagated and grown. The evidence as to which types are the best is very meagre.

Many breeding problems, similar to those mentioned, are of importance and a study of these questions will be taken up at the earliest opportunity. In the study of varieties mentioned in a preceding paragraph, the attempt will be made to determine what characters exist in the citrus group that will be of value for combining into new varieties. The characters should be thoroughly analyzed in order that we may be in position to know what materials we have to work with in producing ideal varieties.

Frost Injury.—The severe freeze that occurred last winter and caused much damage to the citrus industry, created a demand for exact information regarding the effect of cold injury on the various varieties of citrus fruits, and the best methods to use in the treatment of injured trees. The freeze also emphasized the importance of determining what methods can best be used by growers to minimize or prevent the damage from such freezes.

It was important immediately following the freeze, to study conditions throughout the State and get as complete information as possible regarding the lessons that could be learned by careful observation and from the experience of growers. No special funds or men were available for this purpose but in the emergency, funds were diverted from other investigations and a number of investigators assigned to the work.

Several investigators connected with the United States Department of Agriculture and with the State Department of Horticulture also worked in close coöperation with the College of Agriculture in prosecuting the investigation.

Separation of Injured from Uninjured Fruit.—The problem of most immediate importance presented after the freeze, was to determine methods by which fruit that had been so severely injured as to render it worthless for marketing, could be segregated from less severely injured fruit that was still valuable. Careful studies of the changes taking place in frozen fruits was made and the feasibility of making a fairly good segregation based on the different specific gravity of the injured fruits was thoroughly demonstrated. The rate of change in the frozen fruits and the time at which a successful segregation could be made was carefully determined. The best segregations were obtained by the use of denatured alcohol and this method of segregation was used by growers to some extent in the early part of the season.

The water separator, devised and patented by Mr. Frank Chase, based also on the difference in the specific gravity of the injured and uninjured fruits proved very successful and later in the season supplanted all other methods of segregation.

A careful study was also made of the symptoms of frost injury exhibited by fruits and of the chemical changes taking place in injured fruits. These studies were intended to determine methods of separating frozen from unfrozen fruit, as well as to determine any injurious effect from eating frozen fruit. It may be stated here that frozen fruit was eaten in large quantities throughout the citrus belt of California without injurious effect.

The Methods of Handling Injured Trees.—The best method or methods of handling injured trees has been carefully studied with reference to pruning, fertilization, cultivation, irrigation and treatment immediately after the freeze to minimize the injury so far as this is possible. These studies when completed and brought together should furnish reliable information for the use of growers in subsequent freezes.

The Artificial Protection of Groves from Injury by Freezing.—During the freezes occurring last winter, many different methods of protection were used by growers and the benefit derived by such methods of protection are being carefully studied. In order to obtain definite data on the percentage of saving by heating groves, comparative trees in adjoining heated and unheated areas have been marked, on which all fruits have been examined and graded. A considerable number of such comparative trees have been studied in a number of different locations, where different methods of heating were used.

Careful field studies of secondary methods of frost protection have also been made throughout the citrus belt. By secondary methods of protection is meant the use of wind-brakes, effect of irrigation, effect of over or under fertilization, and the like. All factors of any benefit in minimizing the effect of a freeze should be thoroughly understood and utilized.

The results of field studies and experiments bearing directly on the freeze of last winter will be published in full as soon as the extent of the damage can be determined and the comparative value of different methods of treating frozen trees becomes clearly visible. It is expected that the study of frost injury and frost problems will form an important line of investigation at the Citrus Experiment Station.

Walnut Investigations.—The growing of walnuts in Southern California is the second industry in importance, and considerable work will be done on the various important problems. The University has had under way an investigation of various walnut diseases and these will be continued. Here, as in the case of the citrus fruits, one of the most important problems demanding solution is the failure of certain groves, while the trees are yet comparatively young. The solution of the problem will probably demand an investigation of the methods of cultivation, fertilization and irrigation to determine the normal requirements of the tree. No attention has as yet been given to outlining the walnut studies to be pursued and thus no definite report can be made at this time.

Tropical Fruit Investigations.—Considerable advance has been made in Southern California in the cultivation of such tropical fruits as the avocado, or alligator pear, the guava and the like. One of the important lines of work at the station will be the collection and trial of various tropical and sub-tropical fruits and plants that may be of value for cultivation in Southern California. The preliminary part of this work will consist merely of variety tests and will require but little time and study.

Other Investigations.—It is hoped that the investigation of the scientific principles that apply to the development of sub-tropical and tropical agriculture may ultimately be made a strong feature of the Citrus Experiment Station. The basis of all agriculture rests on science and no permanent advance can be made without such studies of fundamental nature. Southern California with its co-mingling of dry farming methods and irrigation methods and its great diversity of crops, presents many difficult and interesting problems. The continued success of agricultural operations in such a region must pretty certainly rest on the improvement of methods and the improvement of crops to fit the conditions.

ADAMS' FUND

The work under the Adams' Fund has been somewhat reorganized so as to apply the money to a few projects which shall be fundamental in character from an investigational viewpoint, and, at the same time, shall be of prime economic importance in California. Three lines of work which come within this category are: (1) The diseases of domestic animals; (2) The diseases of economic plants; (3) Chemical and biological studies with reference to soil fertility. As it will take some time to bring about the reorganization of this fund a few projects now in progress under the Adams' Fund will be continued under this fund for another year. Certain other investigations previously conducted under the fund, (1) Causes of sterility of almond trees, (2) Walnut oak hybrids, (3) Laboratory and field story of cereals with reference to the influence of Environment upon gluten content of grains, will be continued with other funds. A summary of each of the lines of investigation for the fiscal year ending June 30, 1914, is given below:

1. Diseases of domestic animals by C. M. Haring, C. L. Roadhouse and Ralph Bell.

(*a*) The immunization of calves to tuberculosis with "bovovaccine."

(*b*) The intradermal tuberculin test for detecting tuberculosis in cattle and swine.

(*c*) The study of the causes and means of preventing the spread of tuberculosis in cattle and hogs in California.

2. Plant diseases by R. H. Smith and W. T. Horne:

Investigation of the relation of the environment in causing certain plant diseases and unhealthy plant conditions which have become important economic considerations in California; continuation of investigation of fungous root diseases of fruit trees and other plants; and continuation of studies in the treatment of bacteriological plant diseases, including walnut blight.

3. Chemical and biological studies with reference to soil fertility by C. B. Lipman, L. T. Sharp, P. S. Burgess and W. F. Gericke:

Alkali in soils as affecting soil fertility; studies of resistance of plants to alkali salts. Effect of alkali on soil flora. Methods for neutralizing and controlling alkali to be studied by means of cylinder experiments in the field and pot experiments in the greenhouse.

Continued study on the bacterial flora of California soil columns. Relation of bacteria to soil fertility, including studies on the effects of physical and chemical constitution of soils on bacterial flora; inoculation experiments with various species of bacteria. Effects of irrigation on bacterial flora of Imperial Valley soils. Correlation between liming soils and inoculation for legumes.

Studies on the effects on poisonous salts of the heavy metals, including copper, zinc, and lead, on plant development; a practical problem connected with the smelter wastes.

Studies on the lime-magnesia ratio, and also other chemical phases of the soil's composition as effecting production.

4. Entomological studies by C. W. Woodworth and H. J. Quayle:

A detailed laboratory study of the toxicity of the various insecticides, the purpose being to establish the principles involved in their practical application. The investigation will consist primarily of a study of the history and physiology of insects after treating them with known quantities of poison.

Continuation of detailed study of red spiders and elongate scale of citrus trees, including breeding and environment experiments to determine factors responsible for two forms and their geographical distribution; life histories of important citrus insects.

5. Botanical investigations by W. A. Setchell:

Nicotiana hybrids; work with hybrids between different varieties of cultivated tobacco to determine fundamental types in the composition of these varieties.

BOVINE TUBERCULOSIS INVESTIGATIONS

In 1907 provision was made, under the Adams Act, for investigations at this Experiment Station concerning the value of Bovovaccine in immunizing cattle to tuberculosis. These experiments have also given opportunity to make, without extra expense, valuable observations in addition to those concerning the power of bovovaccine. The results of this work have been published from time to time in veterinary and agricultural journals. Following is a summary of the experiments to June 30th, 1913, prepared by Dr. Haring.

Tests of von Behring's Bovovaccine.—Bischoff & Company, American agents for the products of the Marburg Institute, Germany, have been active in selling von Behring's bovovaccine to dairymen in this state. In 1907 it seemed desirable to undertake some experiments to determine its efficiency under California conditions.

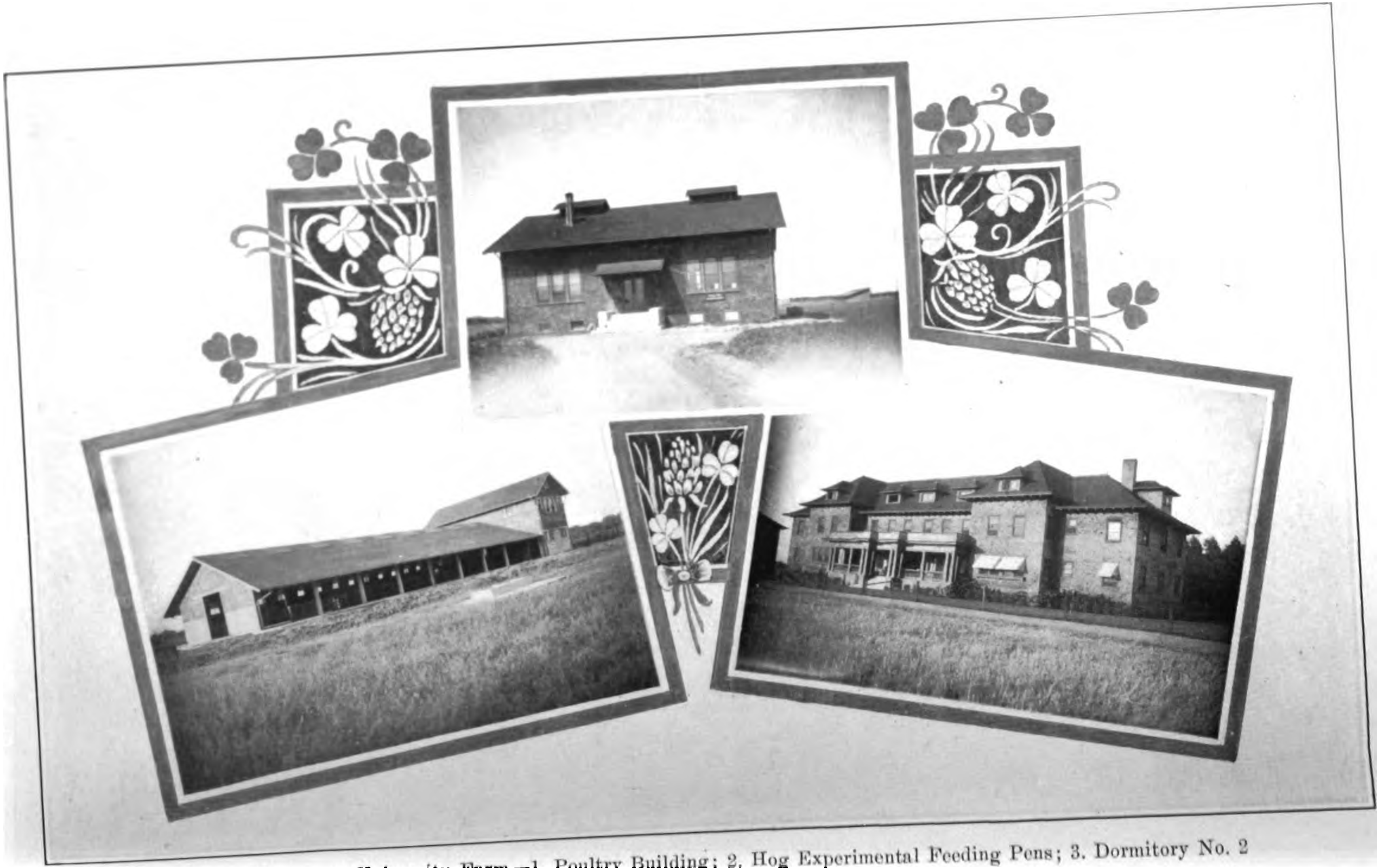
Forty-five calves were secured for the purpose of this experiment, measures being taken to obtain animals free from tuberculous infection. Twenty-two of the calves were treated with bovovaccine after the manner of von Behring and twenty-three were kept as controls. For a year the calves were reared with precautions against tuberculous infection. At the end of eight months all of the calves were tested with tuberculin and none reacted. Even in the bovo-vaccinated calves the hyper-sensitiveness which usually exists for a time in such animals had disappeared.

After having satisfied ourselves that the herd was free from tuberculosis the forty-five animals were subjected to infection by placing in their pasture cattle having open tuberculosis. These were associated with the calves in a twenty-acre pasture and in corrals where they came to be fed. The first lot of tuberculous cows brought into contact with the calves were five in number. Within six months these cows had all died of tuberculosis.

The following spring ten more reacting cows, having evidence of open tuberculosis, were introduced and the infection experiment carried through until the young vaccinated cattle and the controls were between two and a half and three years old. Details of the tests need not be given other than to summarize the final results. They were all autopsied, most of them were killed for beef at about three years of age, under federal inspection.

Of the twenty-two vaccinated cattle, *ten* were tuberculous. Of the twenty-three non-vaccinated cattle fourteen were tuberculous. Bischoff & Company wrote us that if another vaccination had been made when the animals were about a year old, their immunity would doubtless have been increased sufficiently to protect them from infection. And there is reason to believe that this might have been the case. However, even if frequent injection of bovovaccine would keep cows immune, it would be impracticable to vaccinate mature dairy cows with virulent human tubercle bacilli. Our conclusions are that some immunity was produced by the use of bovovaccine, but that this immunity did not remain to any appreciable extent after the third year. We cannot recommend the use of bovovaccine to stock owners.

Laboratory of the Citrus Experiment Station at Riverside



New Buildings at University Farm—1. Poultry Building; 2. Hog Experimental Feeding Pens; 3. Dormitory No. 2

The Spread of Tuberculosis in Cattle under Outdoor Conditions.—In the infection experiments to test bovovaccine, it has been mentioned that the infection took place under outdoor conditions. The disease spread in eight months to twenty-four out of forty-five healthy yearling cattle, confined in a twenty-acre pasture, with cattle having advanced open tuberculosis. The animals drank from a running stream and also from a water trough in a corral opening into the field. During the rainy season they were fed under an open shed.

The Use of Tuberculin in the Diagnosis of Tuberculosis in Cattle.—Considerable data has been collected at this station concerning the tuberculin test. It consists of records of over four thousand tuberculin tests made by members of the Experiment Station Staff. One of the most valuable lessons gained from a study of some of this data concerns the *retesting of recently tuberculinized cows.*

Professor Vallee of the Alfort Veterinary College has published observations indicating that cattle can be successfully retested after the forty-eighth hour following a previous injection of tuberculin. His procedure in retesting was to inject subcutaneously a double or triple dose of tuberculin, i.e., from 400 to 800 milligrams of tuberculin O.T. per 1000 weight, and take the temperature every two hours from the second to the eighteenth hour. With such a dose a distinct thermal reaction was said to occur in cattle that had been previously tested or plugged, the temperature rise usually occurring much sooner than in the original reaction. An experiment was undertaken to verify this.

We had already observed that sometimes tuberculous cattle would not react to a double dose of tuberculin on retest, even after a period of three months, this failure to react being especially frequent in non-lactating cows, i.e., those that had been purposely dried up and segregated because of the fact that they had reacted. When opportunity was afforded to autopsy such cows, the lesions were sometimes found encapsulated, but in six instances active tuberculosis had been proven, two of which were also proven to have excretions virulent to guinea pigs. The fact that these cattle had become ceased reactors could not, therefore, be attributed to an arrest or cure of the disease. It was decided to try Vallee's method on reacting cows in full lactation. The following table shows the results of retests on thirty-seven such cows. The results are based on the injection of 4 c.c. of tuberculin, i.e., 400 mg. tuberculin O.T., diluted with ten parts of physiological salt solution, at the retest, the temperature being taken every two hours from the second to the eighteenth hour after injection.

Number of animals	Reinjected in	Number reacted on retest	Hour at which the temperature rise occurred on the retest	Hour at which the temperature rise occurred on the initial test
3	48 hours	1	9	13
14	58 hours	7	10	12
6	3 days	1	11	9
6	5 days	1	17	12
4	45 days	4	14	12
4	2 months	4	13	14

It is interesting to note in corroboration of Vallee's observations that, in the retests made within five days, the animals reacting to the second injection usually had a rise of temperature sooner than at the first test, but the only conclusion to be drawn is that the retesting of cattle within six weeks is not satisfactory, even when a double dose is used, and the temperature taken every two hours from the time of injection until the eighteenth hour.

Other investigators have since reported observations which corroborate our conclusions that Vallee's method of retesting is of little value.

In addition to the thirty-seven head mentioned above, there has been occasion at various times to make observations on the value of tuberculin in retesting.

One instance in particular is worth mentioning: twenty reacting dairy cows were removed from a dairy, dried up and turned into a mountain pasture. When retested, several months later, eighteen of these twenty failed to react. We do not, however, explain this on the ground that the cows were cured. Outdoor life and fredeom from the drain of milking may possibly cure some cows, but the cases just described show that, although they may improve in condition and cease to react to tuberculin, they may still be disseminating virulent bacilli, and that young, susceptible animals quickly contract the disease, even under an environment which acts with benefit on old and chronically tuberculous dairy cows.

These observations support us in the stand that in removing cows from dairy herds because they react to the tuberculin, no retests should be permitted. We believe the rule should be: Once reacted, always condemned.

The Intradermal Method of Using Tuberculin.—The usual method of performing the tuberculin test, by injecting the tuberculin subcutaneously, cannot be satisfactorily applied to young calves or to wild range cattle, while during the hot season in some of the interior valleys of California the test is valueless, even when applied to docile dairy cows. A modification of the tuberculin test, called the *intradermal method,* is especially adapted to these conditions. This method was devised by two French investigators, Moussu and Mantoux. It is applied by injecting a strong solution of tuberculin into the layers of the skin. The reaction consists of a swelling at the point of injection which varies in size from that of a pea to that of an egg. This method obviates the labor of taking temperatures, and possesses so many other advantages that its acceptance as a reliable method would be a great aid in the eradication of bovine tuberculosis. Investigators disagree as to the best technic and the proper strength of tuberculin to be used in this new method. The question of comparative accuracy of the intradermal, when compared with the usual subcutaneous method, has not been settled.

During the past year there have been tested by the Veterinary Division over five hundred cattle by the intradermal method, including one hundred and seventy-five tuberculous cows on which comparative tests were made by applying both the intradermal and subcutaneous tests. Seven cattle which reacted to the intradermal, but failed to react to the subcutaneous test, have been purchased by this Station and slaughtered. They were found to be tuberculous. Data, which is being collected on the intradermal use of tuberculin, will soon be published by this station in bulletin form.

AGRICULTURAL EXTENSION

In addition to the work of instruction and investigation, the various divisions of the Department of Agriculture are engaged somewhat extensively in the performance of public service to the citizens of the State. For example, the division of Soil Chemistry and Bacteriology has, during the year, examined five hundred and fourteen samples of soil for alkali and fully as many more samples were examined, which did not need alkali determination, but regarding which information was sought as to the adaptability for crops, methods of fertilization, and tillage. Rarely do samples of soil require complete chemical analysis and sometimes only a physical examination is given. This division, during the same period, wrote eighteen hundred letters, upward of ninety per cent of which dealt with information to farmers, growers, land owners, and prospective settlers; in some cases on the basis of samples of soil submitted, in others without such samples where they were unnecessary.

During the year 261 samples of milk and cream have been tested for dairymen. During the same period 130 samples of butter were analyzed in connection with the butter scoring contest.

While the various divisions are thus engaged in public service work, the division of Agricultural Extension is especially organized to render this service, which it does under three general aspects: first, in conducting Farmers' Institutes and attending other farmers' meetings and by the conduct of agricultural educational trains; second, by placing agricultural advisers in various sections of the State; and, third, by advice and counsel from the main office or by visitation of a member of the office staff. Advice and counsel are freely given to any citizen of the State concerning any agricultural matter upon which the department is competent to speak, provided only that the information is not to be used for advertising purposes. Where personal visits are required on the part of the members of the staff the traveling expenses are paid by the party receiving counsel. A very large part of the advice given by this division is by letter, although personal conferences with citizens of the State by all the divisions occupy a considerable portion of their time. As illustrating the demand that is made upon the College of Agriculture for information it may be reported that for the six months ending June 30, 1913, members of the staff of the Department of Agriculture wrote twenty-seven thousand seven hundred and eighteen letters, or at the rate of more than fifty-five thousand letters a year.

A coöperative agreement has been entered into by which an agricultural adviser, Mr. Andrew Hansen Christiansen, has been placed in Humboldt County with headquarters for the year 1913–14 at Eureka. It is understood that the Board of Supervisors of Humboldt County have voted one thousand dollars, the Dairymen's Association of Ferndale and the Chamber of Commerce of Humboldt County have each pledged five hundred dollars toward the work of the adviser in that county. It is expected that this department will expend an equal amount in the furtherance of the work in that section.

During the fiscal year ending June 30, 1913, Institutes were held in thirty-seven of the fifty-eight counties of the State. The number of one-day, two-day, and three day sessions, together with the total attendance based upon the attendance per session, is given below:

1–day	121
2–day	30
3–day	2
Total sessions	367
Total attendance	38,850

In addition to the above general institutes, seven Women's Institutes were held for the first time, the total number of sessions being eight and the attendance being 868. The total attendance at Farmers' Institutes, therefore, based on the number of persons per session, was

39,718. Various lectures were given at Teachers' Institutes and at High Schools with a total attendance of 8,908.

On February 13, 14, 15, 17, and 18, a Frost Educational Special Train was run in Los Angeles, Orange, Riverside, and San Bernardino Counties in coöperation with the Southern Pacific Railroad. In coöperation with the Santa Fe Railroad a Dairy and Swine Educational train was run on April 3–14 and 17–20 through San Joaquin Valley and Marin, Sonoma and Mendocino counties. These two trains covered one thousand miles, made a total of seventy-four stops, employed five lecturers, and had a total attendance of twenty-one thousand five hundred and seventy-seven. It is believed that by sending out trains to accomplish a special purpose and sending with the train thoroughly qualified specialists, work of higher character and of more lasting benefit can be achieved.

AGRONOMY

The work of the Agronomy Division was divided among several points of operation. All instructional work, and the major portion of the laboratory work incident to investigation, was carried on at Berkeley. Field experiments with cereals and general field crops were conducted at the following points: University Farm, Davis; Kearney Park, Middle River, and Meloland, Imperial County. Work on the improvement of lima beans was carried on at Oxnard in coöperation with the Lima Bean Growers' Association, for which purpose $100 was contributed by the Association.

Work at Berkeley.—In the event of the opening of the new Agriculture Hall, and the subsequent re-arrangement of the old building in the fall of 1912, more room was allotted the Agronomy Division. Besides obtaining more commodious office space, a laboratory was secured for student work in Cereal and Field Crops, a separate room from the Coöperative Branch Seed Laboratory, and two smaller laboratories for investigational and research purposes.

The experimental work conducted at Berkeley was confined largely to the chemical analyses incident to the work on wheat breeding and the completion of the investigation on the environmental factors affecting the composition of wheat.

At Davis.—The experiments with cereals were carried on as extensively as usual, including variety trial, fertilizer experiments, rotation experiments, and a number of special experiments. All important experiments were conducted as far as possible, on summer fallowed land, or in a biennial cropping system. The variety trial with cereals was carried on in two groups: (1) nursery planting, and (2) plat planting.

1. The nursery planting included row trials with sixty varieties of wheat, thirty-five varieties or strains of barley, and a few varieties of oats. Besides these, about ninety strains of hybrid wheats were grown in rows for the purpose of comparison and for the establishment of type.

The nursery planting also included breeding and straight selection, with wheat, barley and oats, using the centgener methods. A large number of these projects are under way. As soon as a variety or strain shows some promise it is increased in plats.

By this process of selection, strains of barley and wheat have been secured which have yielded ten and fifteen per cent respectively, higher than the stock from which they originated. Other similar projects are under way, many of which are showing considerable promise.

2. The plat experiments include variety trials with barley, wheat, and oats, grown in plats one–twentieth to one–tenth acre in size. In spite of the small amount of rainfall, the results this season have been fairly satisfactory. Thirty-four varieties and strains of barley averaged 90.87 bushels per acre. The oat plats suffered somewhat more from drouth, though eighteen varieties and strains averaged about 57 bushels per acre. The results obtained on the wheat plats were more erratic. The grain on a few of the plats in the sandier portion of the field either did not head or gave only a very low yield, while some of the more drouth resistant varieties on heavier soils yielded over 70 bushels per acre. About forty varieties and strains of wheat were under trial.

Fertilizers.—The fertilizer experiment composed of twenty-seven plats upon which various amounts and combinations of commercial fertilizers were applied to determine their effect upon the yield and composition of wheat, was continued. Inasmuch as these plats have been cropped every year, they suffered severely from the drouth.

The yield of these for the season is very poor, though the comparative effect of the fertilizer was more striking than in normal seasons. The average yield from the unfertilized plats and the fertilized plats was, 10.3 bu. and 11.6 bu. per acre, respectively. The average yield for the plats receiving phosphorus was 12.2 bu. per acre, an increase of 18.4 per cent over the unfertilized plats. The results tend to show that fertilizers produce a greater comparative effect in a dry year than in a normal year.

Rotation Experiments.—This experiment includes fourteen plats, and is designed to determine the effect of summer fallow and the use of various green manure crops upon the yield of wheat as compared with continuous cropping. Like the fertilizer experiment the plats which have been cropped every year, suffered severely from drouth. From the summer fallowed plats and some of the green manure plats good yields will be obtained.

Seed Selection.—Other special experiments under way are a seed selection project, where an attempt is being made to improve the quality of wheat by straight field seed selection.

For the past season the increased yield of the selected plats over the check plats was not as marked as in previous years. The average yield for the past three seasons is 51.5 bu. per acre for the selected seed plats, and 46.34 bu. per acre for the check plats.

Climate and Soil on Composition of Wheat.—Two other experiments designed to determine the effect of climate and soil upon the composition of wheat are in coöperation with Kansas, Texas, and Maryland. Aside from the moisture holding capacity of the various types of soils, climate seems to exert the greatest influence on the composition of the grain.

Miscellaneous Crops.—In the fall of 1912 a strip of land comprising eighteen acres, was leveled and checked for irrigation. Upon the tract miscellaneous experiments were conducted with field crops and legumes, under irrigation. The principal projects were variety trials, including twenty varieties of beans, ten varieties of Soy beans, a number of varieties of cow peas and field peas, twenty varieties of corn, and about ten varieties of non-saccharine sorghums.

Sudan Grass.—In April, 1913, through the coöperation with Professor C. V. Piper of the Bureau of Plant Industry, an experiment with Sudan grass was started, to determine its value as a forage plant and also for seed purposes. Plats were seeded, both broadcast and in rows, different widths apart, and both with and without irrigation. The irrigated plats gave a good growth, but because of the poor condition of the field and the lack of rainfall, the non-irrigated plats are poor.

Alfalfa Breeding.—This spring an alfalfa breeding plat was also started. The seed used had been hand-picked from promising plats of the leading varieties of the state: namely, Chilean, Turkestan, Arabian and Peruvian.

At Kearney Park.—At the Kearney Park Station the principal experiments in progress are rotation experiments. Biennial cropping experiments, cultural experiments, and variety trials with barley, oats, non-saccharine sorghums and leguminous forage crops, such as field peas, cow peas and vetches.

Rotations.—1. This is a three-year rotation experiment, including wheat, corn (Egyptian, Kaffir and Milo), and sugar beets. The plats are one-fourth acre in size and are cropped every year without any treatment whatever. The corn and sugar beets are irrigated as needed, but the wheat plat is dry farmed. Owing to the small amount of rainfall the wheat is very poor this season.

On the corn plat, four rows of each of the following varieties were planted: Red Dhaura, White Dhaura, Milo (standard), Dwarf Milo and Kaffir.

2. This is a three-year rotation, similar to No. 1, except that every opportunity is taken to add organic matter to the soil. Thus, the plats planted to corn and sugar beets in the spring were seeded to rye the previous fall. The rye was turned under in March and the plats prepared for corn and beets, using the same variety as in the preceding experiment and seeded at the same time.

3. This experiment is for the purpose of comparing biennial cropping to wheat. This season an excellent crop was obtained on the biennial plat, while on this continuous plat the stand was very poor. The results obtained were 35.04 and 26.98 bushels respectively.

Cultural Methods.—1. This is a cultural experiment to determine the value of sub-packing the soil as compared with harrowing in preparing the seed bed for grain. The sub-packed plat gave a yield of 3 bushels more per acre than the plat not packed.

No. 2 is a comparison of the efficiency of deep with shallow plowing in preparing the seed bed for grain. Contrary to the usual results the shallow plowed plat gave a higher yield by 3.7 bushels per acre than the deep plowed plat this season.

In both these experiments Beldi barley is used.

Variety Tests.—The variety tests with grain include about fourteen varieties of barley and twelve strains of improved barley, and a few varieties of oats and wheat. In spite of the small amount of rainfall the grain looked excellent in the field, and some interesting results will doubtless be obtained when threshed.

Eight varieties of non-saccharine sorghums were planted, but are still too young to show results.

The variety trials with leguminous forage crops include ten varieties of field peas, five varieties of cow peas and nine varieties of vetch.

Spineless Cactus.—The permanent cactus plat containing a number of varieties of spineless cactus, secured from the Department of Agriculture a few years ago, was badly injured by frost in January, 1913. It is of interest to note that the major portion of the plants, which had reverted to the spined form, were uninjured, while only a few of the spineless plants survived the frost.

The Imperial Valley Experiment Farm.—The Imperial Valley Experiment Farm, located in Imperial County, six miles east of El Centro, will be continued under the immediate supervision of Walter E. Packard, reporting to this office through Professor J. W. Gilmore, Professor of Agronomy. The expenses of this enterprise will be met from the state appropriations for the Department of Agriculture of the University of California. The purposes of the Imperial Valley Experiment Farm are to investigate local problems, to demonstrate known principles of scientific agriculture and to extend a knowledge of new and better methods of farming to this somewhat unique section. The field experiments to be conducted during the coming season are as follows:

I. Alfalfa experiments.
II. Rotation experiments.
III. Continuous cropping experiments with cantaloups, milo maize, barley and cotton.
IV. Variety trials with barley and wheat.
V. Cultural experiments with Durango and Egyptian cotton.
VI. Manure experiments: to test effect of manure on field and forage crops.
VII. (*a*) Special field planting.
    (*b*) Miscellaneous plantings.

Investigations are to be continued with 90 odd varieties of table grapes, with 75 varieties of deciduous fruits, 150 seedling peaches and pomegranates, and 450 seedling date palms.

Investigations as to the cause and prevention of losses in domestic animals will be conducted under the immediate charge of Dr. Walter Jennings Taylor, reporting to Dr. C. M. Haring. Problems which are of importance in the valley and which will receive special attention are cholera in hogs, skin sores on pigs, infectious abortion in cows and skin diseases in horses. This station has served as an important center for the distribution of hog serum, there being maintained a refrigerator where a fresh supply is always available. Dr. Taylor will also assist, with Mr. Packard, in the extension work by attending Farmers' Institutes in Southern California, by giving advice to farmers concerning the care, management and diseases of domestic animals. There are under consideration plans for irrigation investigations from the agronomic point of view. Studies heretofore have been made from the engineering point of view on such topics as head gates, diversion works, etc. The present plans propose a study of the soils, of the water supply, of the duty of water, of methods of irrigation and of reclamation by drainage. The superintendent, Mr.

Packard, acts as general county adviser, visiting farms and giving advice whenever requests are received. In this way the Imperial Valley Farm has become a vital factor in the development of the valley.

ANIMAL HUSBANDRY

Considerable progress has been made by this Division during the past year, particularly in the production of live stock. While a relatively smaller number were purchased than during the preceding year, the increase due to the production by the breeding stock already at hand has been considerable. One Duroc-Jersey, one Poland China, and one Berkshire boar and four Berkshire sows were purchased to complete the numbers of breeding animals for the hog work. But one dairy animal was purchased, a yearling Jersey bull, while two Short Horn heifers and a Short Horn steer were added to the beef herd. The smallest increase was in the horse department, where only one Percheron mare and one saddle pony were added.

In order to carry on experimental feeding in beef production, 36 head of grade Short Horn steers and spade heifers were purchased and will be used to determine the relative economy of beef production with and without grain in addition to alfalfa hay.

In order to determine the same thing for milk production, 12 head of grade dairy cows have been secured and are being fed at alternate periods on alfalfa hay with and without grain. The milk is weighed and samples taken at each milking and the results of this experiment will be reported later in bulletin form.

The milking herd of pure bred Holstein and Jersey cows has varied in size from 20–24 head and accurate records of the yields of each of these individuals is being kept. Two Holstein cows and one Jersey cow are on official one-year record tests which will be completed in February, 1914. All of the dairy cattle are kept in dry lots and the succulents fed consist of green alfalfa brought directly from the field or corn silage. Alfalfa hay is fed to all of them and a grain ration consisting of barley, bran and in some cases oil meal is fed in addition. One two-year-old Holstein Friesian heifer, Lady Teake Lyons, bred and raised by this Division, and fed as above mentioned, produced 17.849 pounds of butter fat in seven days. This is the California record for an animal of that age and ranks well with the world's records for this age and breed.

In order that the exhibit of live stock at the California State Fair might be more extensive and therefore of greater educational value to the people of the state, this Division last year made an exhibit there.

Twenty-one head of hogs, consisting of Poland China, Duroc-Jersey and Berkshires, 14 head of cattle consisting of 4 Holstein Friesians, 2 Jerseys, 3 Herefords, 2 Angus and 3 Short Horns, and 6 head of sheep—four Southdowns and 2 Hampshires, comprised the exhibit. These 41 head of animals won a total of 46 premiums which included ten championships. The first prize Southdown wether lamb shown by us at this fair was later sent to the International Live Stock Show at Chicago. At that show he won first prize in the open class and first in the college class and was afterwards sold to the University of Ohio.

The Division is in constant receipt of a very great number of demands for breeding stock of the various classes and an unusual effort is being made to fill these demands as fast as suitable stock can be raised for the purpose. During the past year stock of this kind was sold to something over fifty different breeders throughout the state. These animals consisted mostly of breeding bulls and boars, which are to be found at the heads of herds of their various owners throughout the state.

The total live stock sales of the breeding animals above mentioned and for market animals sold during the past year amounted to slightly over $7,000.

But one feeding experiment was completed during the past year and that was with hogs. The results of this experiment are reported in Bulletin No. 237. This experiment was conducted for the purpose of determining whether or not the markets of this state would pay a sufficiently higher price for hogs properly finished on grain in comparison with those not so well finished to make it economical to so finish them. The results show that the hogs receiving the heavier grain ration returned a profit of thirty-three cents per one hundred pounds more for the grain that they consumed than did those fed on the lighter ration.

The work for the coming year in experimental hog feeding will be much more extensive because of the much better equipment now at hand. A hog house 30 feet wide and 100 feet long, with a two-story part 18 x 42 feet, has just been completed. This will make it possible to handle quite a number of experimental hogs at one time, and five lots of 15 each will be put on feed on July 1st of the next fiscal year, the results of which will be available about January 1, 1914. This hog house was designed for convenience and for cleanliness and contains 16 pens 10 x 12 feet, with concrete floors and concrete troughs. Considerable attention has been paid to ventilation in order to provide a place that is sufficiently cool to enable proper feeding during the warm weather. The adjoining pasture lots which are in alfalfa are fenced in one-eighth acre tracts in order to determine as accurately as possible the amount of pork that a given area will produce.

Since pork production is becoming so important an industry in this state, it was thought desirable to organize a Swine Breeders' Association, and through the efforts of members of this Division such an organization was perfected. The first meeting was held at the University Farm on April 17, and 31 members enrolled. Since that time the organization has grown considerably and is now in a position to assist swine breeders with some of their problems.

There was on hand July 1, 1913, live stock as follows:

Horses	18
Dairy cattle	70
Beef cattle	70
Sheep	95
Hogs	145

The value of these will total about $35,000.

NUTRITION

The laboratory investigations comprise some 250 analyses of samples of foods and feeds, analyzed at the request of rural citizens of this state. Among the many results of such work may be listed:

1. The practical elimination of several adulterated foods from the market, such as rice bran, cottonseed meal, oat middlings, etc.

2. The bringing about of a better system, a more economic system, of feeding on the part of a great many who have appealed to the station for assistance.

3. Advice has been given and cordially received with reference to the use of new patent or proprietary foods that have been presented to feeders of the state. It is very gratifying to know that there is no new food used by poultry or cattle men in this state that is not now submitted to the station for advice and suggestion regarding its practical, nutritive and economic value.

A number of elaborate toxicological examinations have been made on cadavers, foods and feeds, most of which resulted negatively but served to guide people in their problems. In some instances, as the examination of sorghum for hydrocyanic or prussic acid, the results have been positive. Also the examination of some foods for strychnine, etc.

An important investigation was carried on the early part of last year on the effect of storage of milk on the disappearance of added formalin. The experiments were carried on at different temperatures and under different environment. The result of this investigation was of considerable moment to the milk commission in disproving some false contentions of some commercial chemists.

The laboratory is at present engaged in the preparation of pure proteids to be used later on in an investigation of the nutritive value of the pure isolated proteids, these pure proteids to be the sole source of nitrogen in the ration.

CITRICULTURE

During the winter of 1911–12, the station orchards at Riverside suffered severely from frost, no provision for orchard heating having been made. During the following summer, orchard heating equipment was installed, comprising an iron tank of ten thousand gallons capacity for storing fuel oil, a tank wagon for distributing oil in the orchard, and an automatic electric alarm apparatus. Fifteen hundred "High-low" orchard heaters were furnished without cost by Mr. W. C. Scheu, the inventor of the heater. During the first week in January, 1913, a very severe freeze occurred, yet while most other citrus orchards in the vicinity were badly damaged, the trees on the station grounds were protected by the heating equipment. Under the direction of Dr. H. J. Webber, who had just arrived, the orchard was fired during the coldest nights, with the result that no trees were killed. The lemon trees lost but few leaves and some of the fruit even on the orange trees was saved.

At present accurate knowledge of the factors influencing seed formation in citrus fruits is almost entirely lacking. Some Valencia orange trees produce seedless fruit. The same is true of Eureka lemons and Pomelos. If the reason for this state of affairs could be discovered and understood, it might be possible to produce and advertise seedless fruits of these varieties. This would be a very great advantage to the growers. For two years, Professor Coit has carried on pollination studies together with morphological work at Whittier and Riverside, and considerable data has been secured. Rather extensive library work has been done on this subject. One or two more season's work in the orchards, together with additional laboratory work, will be needed before the data will be sufficiently complete to draw conclusions.

The raising of seedlings of semi-tropical fruits is being carried on at the Imperial Valley Station near El Centro. Some four hundred specially bred seedlings of the Deglet Noor date are now three years old. With these seedlings, the object has been to combine the excellent quality of the Deglet Noor with the earliness of the Fard. A number of fig seedlings, hybrids between the Smyrna fig and *Ficus pseudocarica* are being grown in an effort to produce capri figs which under the climatic conditions of Imperial Valley will furnish a continuous breeding ground for the Blastophaga, fig wasp. A large number of pomegranate seedlings also are now beginning to bear and it is hoped to secure a type or types resistant to the fruit heart rot so common in that part of the state.

POULTRY HUSBANDRY

During the last year the division has carried on the following experiments:

Nitrogenous Foods.—A one-year experiment to find the relative values of soy bean meal, meat scrap and fish scrap as protein feeds for laying hens, in which careful data is being secured showing the effects of these different feeds on (*a*) the number of eggs laid, (*b*) mortality, (*c*) effect of high grade fish scrap on the flavor of the eggs, (*d*) keeping quality of eggs when stored, (*e*) condition and health of the fowls under experiment, (*f*) fertility and hatchability of eggs set, and (*g*) livability and vigor of chicks hatched.

Turning Eggs during Incubation.—An incubation experiment to find the relative effects of different amounts of turning on the number and quality of the chicks hatched artificially.

Temperature of Incubator.—An experiment to find the relative effects of different degrees of temperature on the number and quality of the chicks hatched artificially and the vigor and livability of said chicks until well grown.

GENETICS

Genetics is a recently recognized branch of biological science. It is the purpose of the Division of Genetics to conduct original investigations in the study of variation and heredity. Both plants and animals have certain advantages and disadvantages as material for use in the study of genetic problems. Hence the student of genetics must be ready to resort to the use of any living organism that gives promise of revealing the natural laws upon which the future science of breeding will be grounded.

Walnut-Oak Experiments.—Since 1907 Professor Babcock has carried on an investigation of a new form of California black walnut, and the first report of this study will soon be printed.* In studying the origin of this form it seemed desirable to attempt to produce hybrids between oaks and walnuts, particularly between the coast live-oak (*Quercus agrifolia*) and the California black walnut (*Juglans californica*). Therefore, crosses were made in 1908, 1909, 1910 and 1911, and as a result there are now growing upon the campus at Berkeley 84 seedlings that grew from nuts produced by female walnut flowers which were pollinated with live-oak pollen under bags. Two attempts to secure acorns from the reciprocal cross failed. These seedlings appear like black walnuts but show great variation. About forty of those produced from the 1908 crosses bloomed at the age of four years, and from flowers self-pollinated under bag on these trees a number of second generation seedlings will be grown in the spring of 1914. Meanwhile microscopical examination of developing walnut flowers in various stages will be made.

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*See Univ. of Calif. Publications, Agricultural Science Series, vol. 2, no. 1.

Potato Improvement.—Variation in the Burbank potato and the possibilities in tuber-unit selection have been under investigation for two years. In 1911 a sack of Burbank potatoes was bought in the open market, each tuber was quartered lengthwise, the pieces planted singly in hills, and each unit of four hills marked with a stake. The variation in top growth and in yield were so striking that thirty-five of the best units were selected for future observation. In 1912 two crops were grown from these (although only ten unit strains were retained in the second 1912 crop) and this caused the second crop to mature later in the autumn. Under these adverse conditions surprising changes in relative yield occurred. Nine of these ten unit strains are being grown under normal conditions this season to see whether they will return to their former relative position in yield. All the units remain decidedly uniform in vegetative characters, except one which exhibits two types of top growth.

Hybrid Lilies, Brodieas and Calochorti.—Mr. Gilkey has already done considerable work in hybridizing various species of bulbous flowering plants. The result of his work and much new material have been brought together in the plant breeding garden on the campus. This work gives promise of valuable new varieties, not only in the above named genera, but also in Delphinium, Aquilegia and Eschscholtzia.

Peach Hybrids.—Three years ago, in coöperation with Mr. C. O. Smith of the Southern California Pathological Laboratory, Professor Babcock made a series of crosses between the Chinese saucer peach (Peen-to) and certain commercial varieties. The resulting hybrids have not yet been sufficiently tested, but the young budded trees will be ready to set out in the trial orchard at the University Farm this season. The purpose of this work is to combine the hardiness and vigor of the Peen-to with the desirable qualities of the standard commercial sorts. It may be necessary to make further crosses in order to secure this end.

Disease and Drought Resistant Cucurbits.—With the idea of developing new strains of drought and wilt resistant Cucurbits, a large number of crosses will be made during the present growing season between our native Calabazilla (*Cucurbita foetidissima* H.B.K., a small yellow gourd) and several varieties of melons, pumpkins and squashes.

PLANT PATHOLOGY

Walnut Blight.—Bulletin 231 has been published, discussing various phases of walnut blight. This brings together the various results thus far obtained after several years of study. Walnut blight has not thus far yielded to any simple methods for control, and this bulletin gives the various studies which have been made and the status of the problem. It cannot be stated that direct remedial measures are entirely futile, but on the other hand careful study and experience have failed to demonstrate efficiency in any of the treatments, such as spraying with fungicides, up to the present time. The matter of control has, therefore, been thrown into the field of searching for resistant or immune varieties and the effect of cultural measures. This has involved a study of the botanical features of different species and varieties of walnuts. The information thus far available concerning the behavior of the different species and varieties of walnuts when hybridized, either in nature or artificially, is discussed. It may be fairly said that this bulletin presents the more important facts concerning resistant varieties which have been established up to the present time. The point of view in this study has been that of securing successful commercial walnut production, and the technical studies have been regarded only as a step to this end. The blight immune varieties are evidently of no particular interest to commercial growers, unless they prove also to be highly profitable, and this point of view has been carefully kept in mind.

These measures furnish no relief to growers of walnuts whose groves are now large and in full production. Therefore, the spraying experiments which are being carried on have been instituted to see if it were not possible, by means of modern machinery, to do an efficient job of spraying, since it was reported that blight was controlled by spraying when studies of the subject were first made, but spraying machinery heretofore in use has not been adequate for covering large trees. While these operations are still in process, it is probably safe now to say we have succeeded in spraying walnut trees with a degree of efficiency which should answer the question as to whether efficient spraying will be effective in the control of blight. The effects of this spraying on the blight have not yet become evident, and there is danger that owing to drought the walnuts may fail to produce a normal crop, so that the experiment will need to be repeated another year. However, machinery has been perfected and is apparently satisfactory for the work. It merely remains now to determine whether the work is efficient when properly done.

The studies in progress upon various physiological diseases of citrus trees in the south have not yet had time for giving definite results, and certain of the experiments have been considerably interfered with by frost injury to the experimental plants during the past winter. In this connection a discovery, which may turn out to be of very great importance, has been made by Mr. E. E. Thomas, who has found that a new species of nematodes attacks the roots of citrus trees and apparently is associated with the condition known as mottled leaf or decadence. Mottled leaf as a symptom is by no means to be considered as demonstrating the presence of these nematodes, but as a symptom it may be brought on by many unfavorable conditions. The particular credit to which Mr. Thomas is entitled in this connection is in showing that certain nematodes penetrate and become attached to the roots. The suggestion of injury by nematodes has been frequently made and Mr. Hodges, horticultural inspector at Covina, no doubt is entitled to credit for the suggestion that mottled leaf is due to nematodes. It remains to be shown, precisely, the extent of the injury which is caused by these nematodes, and remedial measures must then be worked out.

Progress of a technical nature has been made in connection with gum diseases and various other physiological troubles of citrus trees. The station has benefited greatly by the presence of Mr. H. S. Fawcett, plant pathologist of the California State Commission of Horticulture. It was fortunately possible to give him suitable quarters for his work at the Southern Pathological Laboratory, Whittier. Coming as he did fresh from work in Florida on citrus problems, his suggestions and ideas have been very helpful to the citrus industry. He has been investigating the question of fungi as a causative agent in lemon gummosis with very great success, finding that the disease is produced in a great many cases by the *Botrytis* and brown rot organisms. It was in connection with this work and in an attempt to get still deeper into the nature of the disease and to find if possible whether or not there was such a thing as purely physiological gummosis that the biochemical investigation was undertaken. The so-called black rot condition which apparently verges into foot rot, has been studied and some progress made, which goes to indicate that this condition is not due to a specific organism but is a true physiological disease.

Mr. C. O. Smith has published the results of a number of years experimenting with crown gall in Bulletin 235. A very valuable feature of this work is the possible discovery that certain strains of plums have a certain amount of resistance to crown gall. If these strains of plums shall prove to be actually resistant and they shall also prove to be suitable stocks for various stone fruits the discovery will be of exceedingly great value in California. It may almost be said that all the peach and almond orchards in the state are infected with crown gall. The loss of trees which die every year from this disease is not definitely known, but it is certainly very great in the aggregate; and the loss of production through the depressing effect of crown gall present on many apparently healthy trees is, no doubt, greater than the loss from trees which die.

Mr. Smith has also isolated and demonstrated the pathogenicity of a certain bacterium which causes a black spotting on the rind of citrus fruits, being probably the first demonstrated bacterial disease of citrus. This, however, is one of the minor fruit blemishes and is mainly of technical interest.

Mr. E. E. Thomas has worked out a method for introducing the disinfectant into the lemon washers for preventing brown rot, which promises to be a decided improvement on methods now in vogue.

Mr. S. S. Rogers has completed a bulletin, No. 239, on "Tomato Diseases and Tomato Culture" for the use of growers, bringing to them the most approved methods now known for California conditions. A very serious disease of tomatoes has been studied by Mr. Rogers and apparently its cause has been shown not to be a fungus, as has been previously supposed, but the reaction of the plant to certain features of the environment. The so-called tomato wilt, while still under investigation, will probably be proven to be due to climatic conditions.

Considerable time and effort have been expended in the study of the oak fungus disease, or fungus root rot, a parasitic disease which slowly kills out areas in the orchards, which areas remain unsuitable thereafter for the planting of trees for a considerable length of time. The study of the olive knot disease has also been continued, but neither remedies for this nor the fungus root rot have been finally and conclusively worked out, although it is believed that progress is being made with them.

One of the most brilliant and fundamental results accomplished during the year has been the work of Mr. R. E. Clausen, a graduate student, whose work was largely accomplished during his senior year. This concerns the so-called wither tip disease of citrus fruits, and shows conclusively that in Cuba and Florida an active parasitic disease of limes, and possibly of lemons, exists; but that this disease, so far as we have been able to determine from greenhouse experiments, does not affect either oranges or grapefruits, but is confined to the lime and possibly the lemon. The fungus to which wither tip has been ascribed (*Colletotrichum gloeosporioides*, Penz.) is entirely distinct from this fungus which causes the active disease of limes (*Gloeosporium Limetticolum*, R. E. Clausen), both in its botanical characters and in its physiological characteristics. Mr. Clausen's work very emphatically substantiates the contention of Professor R. E. Smith that so-called wither tip is not an active disease of healthy citrus trees in California, and it puts the whole question of wither tip disease, so-called, in a status that calls for a careful re-working of the whole subject. It will be noticed that this does not solve the question as to whether citrus trees should be sprayed with a fungicide, but it puts the question of spraying citrus trees with a fungicide in the same category as spraying potatoes when blight does not appear. The results of the Geneva Station would seem to suggest that it may pay to spray potatoes for blight, regardless of the appearance of the disease itself; and it may pay to spray orange trees with fungicides aside from the existence of any destructive fungous disease.

ENTOMOLOGY

Fumigation.—The Leakage Gauge perfected last year (Circular 75, Bulletin 220) has been tested out commercially the past year and introduced into Chili and several foreign countries.

Tent Material.—A rather extensive study was made last year of the texture of fumigation tents to discover the character of weave which would combine strength and tightness, the results of which will be published at an early date.

The Killing Strength of Cyanide against scale insect eggs was studied during the hatching season of May and June. Decided progress was made in perfecting the method of study by the substitution of the iodine determination of cyanide in the place of silver nitrate and the perfection of a small gas meter to replace the aspirator bottles formerly used. This enables one to measure the amount of air containing any desired quantity of cyanide, instead of measuring the amount of cyanide in a certain quantity of air.

An account will be immediately prepared of the apparatus with a wider application, and will also bring together the data secured this season with that of two years ago upon the relation of time of treatment and strength of gas required to kill the eggs of scale insects.

Spraying.—With the idea that the efficiency of sprays is largely dependent upon the quantity and distribution of the insecticide, experiments have been planned covering (*a*) *spraying practice* relation between quantity of spray and size of tree for different sprays and crops; (*b*) *the testing of spray nozzles*: for this purpose a very elaborate testing laboratory was installed the present year, including

1. High pressure (250 lbs.) motor driven spray pump.
2. Air chamber pressure equalizer for pressure up to 100 lbs.
3. Air compressor, motor driven to charge the pressure equalizer.
4. Paired pressure gauges and water meters and stop clock for comparisons of nozzles.
5. Track and control mechanism for directing the steam for the study of the distribution of the spray.

The Experiment Station now has the largest collection of spray nozzles ever assembled, including a number of specially designed experimental nozzles.

Cyanide Burning.—While unfortunate weather conditions prevented the consummation of the former line of study, very unexpected and significant results were obtained upon cyanide burning completely demonstrating that the sulfuric acid was alone responsible for this damage.

The experimental work was carried on through the spring term with the assistance of Messrs. Ong and Ochsner and is completed and will be ready for publication at an early date. There remains a considerable amount of work to be done in the study of the physical and chemical conditions of generation which it is proposed to follow during the coming fumigation season.

The determination of *insecticide co-efficients* is the primary object of the studies undertaken under Adams Project No. 7. A large mass of data has already been secured upon the killing strength of different arsenicals, the comparison of ant poisons, of fly poisons, of flea powders, the time of treatment and strength required of carbon bisulfid, but in nearly all of these lines very discordant results are obtained as other investigators have also found. In some of this work publications can be prepared the coming season, but for most of it instead of publishing the data in their present form it has seemed wise to hold them until further studies have enabled us to so interpret these results as to explain their inconsistencies. Manifestly physiological differences in the subjects of the experiments are accountable for the greater part of the variations observed.

Three lines of work have been inaugurated:

1. A microscopical study of the insect. Results already secured are the discovery (*a*) of means of recognizing degrees of hunger by the location of the nuclei in the stomach cells, (*b*) a means of staining the living insect so as to follow the progress of the effect of arsenic on the various tissues, (*c*) the determination of the effect of a large series of chemicals in the determination of polymorphism in aphids, (*d*) the perfection of a new apparatus for parrafin infiltration.

2. The perfection of a method of experimentation by which can be secured subjects for study that are physiologically uniform. The control of temperature has proven to be the most significant factor. (*a*) Means have been perfected for maintaining the higher temperatures and possibly may prove adaptable for all temperatures, (*b*) distinct progress has been made in the method of administering the poison, better than has been used by any other experimenter, but still not wholly satisfactory, (*c*) considerable attention has been given to the selection of species to serve as standards of comparison.

3. The study of the direct effect of external conditions upon the physical conditon of the insect. The study has already covered (*a*) the effect of fixed and varying temperature on longevity, (*b*) very extensive data on the respiration losses in both the feeding and the fasting insect, (*c*) a beginning has been made in the excessive and scanty water supply upon insects.

The ultimate object of the whole study is to enable us to state in simple unmistakable terms the relative insecticidal value of the various substances used for this purpose and under what conditions and to what extent variations may be expected from the normal efficiency.

Citrus Insects.—Professor Quayle has studied the life histories of the principal pests of citrus trees and has completed a series of studies presented in Bulletins 214, 222, 223, 226, and 234, the last of which was largely done in the fiscal year just past. He began, before leaving for his sabbatical year, the study of the scale known as the elongate scale, which has been confused with the soft brown scale in past years. This has been continued under Professor Woodworth's direction by Mr. Campbell and will furnish material for another bulletin, the publication of which can be delayed until Professor Quayle's return, so that his personal knowledge may be drawn upon. Professor Quayle is spending the year in the study of the citrus insects of other countries and is giving particular attention to the red spiders and will doubtless have the material for a very comprehensive report on the subject.

Miscellaneous.—Professor Herms has given attention to the question of rural sewage disposal, has made a study of poultry parasites, of cockroaches and of the means of killing housefly larvae in manure, upon each and all of which studies he expects to complete and present a bulletin during the coming year.

Mr. Nickels has in manuscript a bulletin tracing the life history of the Codling moth in the Sacramento Valley. He has also given a good deal of attention during the past year to the insects attacking dried fruit, particularly raisins; he has experimented on a large scale with the fumigation of raisins, and has worked out a very practical plan of packing house management based on the facts of their life history, to circumvent these insects.

The insects attacking cereals have received attention during the past two seasons. It seems to be clearly demonstrated that the grain weevil is able to thrive only within rather narrow limits as regards moisture. Experiments are now under way to determine exactly what these limits are. It seems likely that with this knowledge loss from this source can be entirely avoided by properly timing the removal of the grain to the warehouse.

Demonstration Work.—A very extensive and successful mosquito campaign has been carried on under the department's direction by the cities of San Mateo, Burlingame and Hillsborough.

Mr. Colman has superintended a successful effort to protect the oaks about Santa Barbara from fungus and insect troubles and will have ready a report on that subject which will be of interest, particularly in the coast regions.

SOIL CHEMISTRY AND BACTERIOLOGY

Smelter Wastes.—The study of the poisonous chemical compounds in smelter wastes made in two different types of soils, namely, an adobe soil with improvement in texture by adding organic matter and another in which no organic matter was added, has definitely confirmed the results obtained in preliminary investigations of last year as to effects of smelter wastes in irrigation water on crop production. It is demonstrated that amounts of copper, zinc, lead and iron in quantities far in excess of those which have ever been found present in the soils of the neighborhood of smelters are inoccuous or even stimulating to plant growth.

Ammonifying Bacteria.—A new study of the physiological efficiency of pure cultures of ammonia producing bacteria in their relation to the availability of nitrogen in various organic fertilizers has added some very definite information on a subject which has not been more than once carefully studied and that as far back as the early nineties of the last century. The different organisms show widely varying powers in making available the nitrogen of organic fertilizers. A marked efficiency in the case of one fertilizer is no indication at all as to what it will do with another fertilizer; for example, the most efficient ammonifying bacteria when tankage is used may be very weak when dried blood is used and vice versa. These results bear on the more complex problem of soil inoculation with pure cultures which will undoubtedly come more and more to engage the attention of soil chemists and bacteriologists in the future.

Endurance by Bacteria of Alkali.—In a continuation of studies on the effects of alkali on soil bacteria both in the form of single and combined salts the limits of endurance of alkali for the various groups of soil organisms have been definitely shown and also the protective action which one alkali salt may exercise over soil organisms when it is added to another toxic salt, despite the fact that each, alone, of these salts is poisonous. Thus it has been found that ammonia production in soils in accordance with the last statement is enhanced by the addition of sodium sulphate to common salt, sodium carbonate or black alkali to common salt and sodium sulphate to sodium carbonate.

Tolerance of Orange Trees to Alkali.—A large amount of data in greenhouse pot experiments on the resistance of plants to alkali has also been adduced in the past two seasons.

These data show the tolerance of the plants tested for alkali with all the alkali salts and give similar indications to the work with the bacteria of the protective action of a given salt for the plant when it is added to another toxic salt while each of these alone is poisonous. Similar experiments have gone farther with young orange trees in the greenhouse, now in their third season of growth and indicate that the orange seedling is resistant to black alkali to an extent hitherto thought impossible; that it is even more strikingly resistant to sodium sulphate or glauber salt and that it succumbs readily to amounts of common salt exceeding .1 per cent and is markedly injured by amounts exceeding .05 per cent.

Lime-Magnesia Ratio.—Studies on the lime-magnesia ratio as related to the growth of orange seedlings in the greenhouse by the use of calcium and magnesium carbonates adds more evidence as regards citrus trees to that recently adduced by Gile of the Porto Rico station and thoroughly refutes the principle, as one of general application, which was laid down by Leew in 1892. Magnesium carbonate is very toxic to orange seedlings; calcium carbonate even when present to the extent of 11 per cent of the dry weight of the soil or more is not toxic. All additions of calcium carbonate to magnesium carbonate have failed to reduce the toxic effects of the latter.

Tolerance of Cotton to Alkali.—Greenhouse experiments on the resistance of cotton to the individual alkali salts indicate that the plants just named exhibit a tolerance to sodium chloride and sodium sulphate which is far in excess of that manifested by all other known crop plants. This resistance to sodium carbonate, however, is not so great because the sodium carbonate readily corrodes the root crown and destroys the root of the plant. If means are used, however, to prevent the action of the sodium carbonate on the root crown of the cotton plant it will withstand very much larger amounts of that salt than other crop plants.

Temperature of Irrigation Water on Orange Seedlings.—Greenhouse experiments on the effect of the temperature of irrigation water on the growth of orange seedlings in pots now in their third season of growth indicate that water at a temperature of 39° F. and 44° F. is injurious to the development of the plants. The injury manifests itself merely by stunting the growth rather than by any other marked symptoms of disease. Orange seedlings irrigated with water at higher temperatures than those above mentioned and going up in these at uniform intervals of 5° F. to 88° F. do not show any differences which can be attributed to the temperature of the water.

Nitrogen Fixing Bacteria.—Studies of the nitrogen fixing flora of the Azotobacter group have been completed on 56 foreign soils, representing many far distant soils of the world. Descriptions of the species found together with a statement of their physiological efficiency and their relations to the California flora will soon be ready for publication.

Analytical Methods.—More information has been adduced from studies on the method of determining phosphoric acid in soil, and on the method for determining nitrogen in humus, the results of both of which have been published in the Journal of Industrial and Engineering Chemistry.

VITICULTURE

The more important investigations undertaken or carried on during 1912–13 are listed below:

Improvement by Cutting Selection.—The possibility of improving the bearing of grapes by careful selection of cuttings is an ancient and widespread belief among grape growers. The possibility is denied by some modern investigators. An attempt is being made to obtain experimental evidence in the matter.

Pruning and Treatment of Young Vines.—The average vineyard in California does not bear a paying crop until the end of the fourth year. Some vineyards pay a year earlier. Our vines show that, under specially favorable conditions, with proper treatment, two years may be gained.

Grafting.—Many thousands of bench grafts have been made at Davis. Most of the grafting was done to supply planting stock for the resistant plots at Davis and Kearney and to give instructions to students. Much of the work was given an experimental character so that considerable light has been obtained on the best methods of making the grafts, treating the cuttings and callusing. Methods of hastening and insuring the processes by hot-room callusing and treatment to prevent molding, were tested.

Extermination of Morning Glory.—In 1910 an experiment was made to test method of eradicating the pernicious weed *Convolvulus arvensis,* as reported in Circular 69. That the method was completely successful is proved by the fact that none of the weed has appeared since in the twenty acres treated.

Disinfection of Cuttings and Roots with Hot Water.—The horticultural quarantine regulations of California forbid the taking of vine cuttings into certain sections, owing to the danger of introducing Phylloxera. The efficacy of disinfection by immersion in hot water was tested. The results were that, while the method is safe in competent hands, the safety factor is too small for general use. That is to say, the point in time and temperature at which all phylloxera are killed with certainty, is too near the point at which the vines are injured seriously.

Dynamiting in Young and in Old Vineyard.—A test was made of the resulting of exploding a small charge of dynamite in the place where a young vine was to be planted. A portion of a block was treated in this way. The results were not satisfactory. Where the blasting was done, the soil was rendered too open and the vine required more water, but made no more growth. All the ground had been plowed fourteen inches deep before planting and the check vines grew very well. In other or less thoroughly prepared soil, blasting might be an advantage.

A block of the old Muscat Vineyard was also blasted with dynamite between every four vines. No difference of vigor or crop was noted between treated and untreated blocks.

Effect of Time of Pruning.—At Davis and in a vineyard at Modesto, series of tests were made to determine the effect of pruning at different dates. Some striking results were obtained. In a general way, it was found that the later the pruning, the later the starting of the buds. As much as fourteen days' delay was obtained in this way. One vineyard was completely protected from a spring frost by this means. Later pruning was found to increase the bearing of Muscats.

Effect of Injection of $Cu\,S\,O_4$ *on Vines.*—Some interesting results were obtained by injecting dilute solutions of copper sulfate in vines badly attacked by Little Leaf. The treatment seemed at first to effect a cure, but the disease appeared with equal intensity the next year.

This result suggested the treatment of cuttings with copper sulfate before planting. In certain concentrations, the copper sulfate was found to stimulate growth and vigor of the young vine, especially with defective cuttings.

ENOLOGY AND ZYMOLOGY

Many minor investigations are continually being made in the Enological Laboratory to answer questions that arise. The lines of investigation, to which considerable time has been devoted, are listed below:

Yields of Grape Juice, Wine and By-Products in Practise.—Through the courteous coöperation of John Swett and Sons of Martinez, we were enabled to follow a complete vintage in a commercial winery of moderate size. An exact account of the amount and character of the raw material (grapes), of the methods of treatment and of the amount and character of the product was kept. The object of the investigation was to see by how much the ordinary practical yield failed to reach the maximum theoretical yield and to devise methods for preventing losses.

Utilization of Waste Products of the Winery.—Some observations as to the amount of the waste products, some analyses of their composition and some tests of methods of utilizing them were made.

Tests of the Newer Methods of Grape and Wine Handling.—Pure yeast apparatus was designed for several cellars. This was installed and put in operation under our advice.

Various experiments were made in the shipping of wine grapes, showing the defects of present methods and indicating effective ways of obviating them.

A small diffusion battery was constructed and tested for the better extraction of wine from fermented grapes.

Composition of California Grapes.—Various minor investigations were made with the coöperation of wineries into the relation of the balling degree and sugar of the grapes and the alcohol of the resulting wine. with the special object of obtaining data on the average non-sugar contents of California grapes.

Various tests were made regarding the effect of fermenting grapes at extremely low temperatures and on some new methods of producing sparkling wines.

Vinegar Making.—Considerable attention has been given to the methods of manufacturing wine and cider vinegar. Most of the work has consisted in examining vinegars and factories, both of which were found usually to be very defective. In several cases, it has been possible to give advice which has resulted in improvement.

Tanning.—A study of the bacteria concerning "bating" resulted in the isolation of a form which could be used to improve the process and make the results more certain and uniform.

INSTRUCTION

During the year the Academic Council has increased the requirements for the junior certificate in the College of Agriculture by requiring one hundred and thirty units instead of one hundred and twenty-four units and by additional prescribed work in natural science. The additional six units are to be gained by the students by taking a field course of eight weeks immediately following the close of the sophomore year in the major subject in which the student is interested. The twelve units of technical agriculture required for the junior certificate have been prescribed to consist of three units each of Agricultural Chemistry, Soil Technology, Plant Propagation, and the Breeding of Plants and Animals. In addition to these and the fundamental studies in English, foreign languages, history, economics, and mathematics, which are required for the junior certificate, the following work has been prescribed for graduation from the College of Agriculture: one year each of general botany and general chemistry, and one half-year each of general zoology, general physics, bacteriology, geology or physical geography, trigonometry and mechanical drawing. But the last two are required only of those who have not entrance credit in those subjects.

During his sophomore year the student is expected to announce the major subject in which he intends to specialize during his junior and senior years. To assist students in making their decisions and to guide them in arranging their programmes, a suggested course of study for junior and senior years has been prepared for each major subject. These, together with a general programme guide for freshmen and sophomores, have been published in the prospectus of the College of Agriculture. The major subjects now offered are: Agricultural chemistry, agricultural education, agronomy, animal husbandry, citriculture, dairy industry, entomology, irrigation, landscape gardening and floriculture, nutrition, parasitology, plant pathology, pomology, poultry husbandry, soils and fertilizers, viticulture and enology. The student is required to take at least ten units of junior or senior work in his major subject, besides writing a thesis during his senior year upon some topic pertaining to his major subject. He must also complete twenty-two units of equally advanced work, ten of which are correlated with the major subject and twelve chosen from any agricultural divisions. The remainder of the upper division work, normally about twenty-eight units, may be freely elected.

The effect of this legislation will be to require more fundamental training in the sciences, and to bring each student to the junior year with a known and comparatively uniform training. The character and methods of instruction have been given much serious consideration by the agricultural faculty. Brief and fragmentary courses have been eliminated. In general, lecture courses are to occupy three or more hours each week and laboratory courses are to consist of six or more hours. The principle is recognized that three hours of effort upon the part of the student are required for one unit of credit.

There has been a somewhat steady increase in the number of University students enrolled in the College of Agriculture since 1905 as shown by the following table:

NUMBER OF STUDENTS ENROLLED IN THE COLLEGE OF AGRICULTURE, 1905–1913

	1905—6			1906—7			1907—8			1908—9			1909—10			1910—11			1911—12			1912—13		
Freshmen	23*	0†	23°	24	3	27	20	0	20	42	3	45	62	1	63	96	1	97	91	9	100	134	9	143
Sophomores	23*	2†	25°	22	2	24	25	3	28	20	1	21	40	1	41	64	3	67	95	1	96	97	5	102
Juniors	17*	2†	19°	14	0	14	21	1	22	24	2	26	23	0	23	42	0	42	65	5	70	94	3	97
Seniors	13*	0†	13°	18	1	19	18	0	18	24	1	25	27	2	29	24	3	27	54	2	56	60	3	63
Special Al & Lim.	39*	4†	43°	39	4	43	35	0	35	38	0	38	42	2	44	44	3	47	45	5	50	42	6	48
Total undergraduates	115*	8†	123°	117	10	127	128	4	132	148	7	155	194	6	200	270	10	280	350	22	372	427	26	453
Graduates	4*	1†	5°	8	3	11	13	1	14	18	1	19	17	3	20	27	3	30	33	4	37	30	7	37
Total	119	9	128	125	13	138	141	5	146	166	8	174	211	9	220	297	13	310	383	26	409	457	33	490

* Men. † Women. ° Total.

The teaching activities of the various divisions so far as applied to University students are shown in the following table:

1912	1st Sem.	2nd Sem.
Agricultural education..	71	26
Agriculture	323	111
Experimental agronomy	21	....
Agricultural technology	2	18
Horticulture	7	775
Agricultural chemistry..	7	6
Insect biology	129	240
Insecticides	99	117
Parasitology	113	159
Plant pathology	96	26
Soils	118	64
Nutrition	140	212
Veterinary science	3	50
Animal industry	....	78
Dairy industry	53	97
Total	1182	1979

1913	1st Sem.	2nd Sem.
Agricultural education..	69	51
Agriculture	591	202
Experimental agronomy	33	15
Agricultural technology	34	1
Horticulture	82	604
Agricultural chemistry..	5	6
Insect biology	85	275
Insecticides	84	92
Parasitology	87	35
Plant pathology	86	58
Soils	118	228
Nutrition	181	209
Pomology	......	71
Landscape gardening....	......	107
Floriculture	......	19
Veterinary science	103	66
Animal industry	......	100
Dairy industry	63	57
Plant pathology (U.F.)	......	14
Poultry	......	17
Farm mechanics	......	16
Viticulture	......	67
	1621	2310

Several of these divisions also give instruction to University Farm School students, notably animal husbandry, dairy industry, poultry husbandry, pomology, viticulture, citriculture, agronomy, and veterinary science.

Most of the departments in addition to the instruction carry on investigations as well as taking part in much of the public service activities of the college and station. The policy is to organize each division so that certain men give their time wholly to investigational work, while others give their efforts to teaching, or a given individual gives one semester to instructional work and devotes the remainder of the year to research or public service activities.

University Farm School.—During the year the character of instruction in the farm school has undergone some modification, approaching more nearly that of collegiate character and rather less like the high school, due to the fact that the young men in attendance are of college rather than of high school age and maturity, though many of them may lack the educational preparation for admittance to the college or university. Changes have been made in the courses with a view to strengthening them for the ensuing year, especially along horticultural lines.

The number of students attending the University Farm School since it was opened is as follows: January to May, 1909, 18; 1909–1910, 43; 1910–11, 85; 1911–1912, 100; 1912–1913, 157.

In accordance with the act establishing the University Farm School, Farmers' Short Courses are given each year during October and November to the more mature citizens of the state. The attendance, which is limited to those who are 18 years old or over, is shown below:

Course	1908	1909	1910	1911	1912
General agriculture	20	11	22	39	78
Animal industry and veterinary science	30	12	32	21	43
Market milk and cream supply	A	5	10	....	....
Dairy farming	B	....	....	27	53
Dairy manufactures	24	18	29	25	24
Horticulture and viticulture	21	12	31	52	50
Poultry husbandry	24	9	32	30	28
Home economics	....	....	C	20	19
Total	119	67	156	214	295
Deduct for registration in more than one course	10	4	33	51	108
	109	63	123	163	187

A. Held only in 1909 and 1910.
B. First held in 1911.
C. No record kept. First held in 1910.

Summer Courses.—Hereafter students will be required to take a summer course of eight weeks in connection with the proposed major subject at the close of the sophomore year. Work is carried on as far as possible just as in actual practice. This year the courses were voluntary. Four students elected field practice at the University Farm at Davis under the general supervision of Assistant Professor John I. Thompson.

Summer Traveling Course in Citriculture.—Fourteen students enrolled in and completed this course. With Professor Coit, assisted by Mr. Condit, the work began on May 15th at Fresno and extended over a period of six and a half weeks, during which time, the entire days were spent in studies and practice work in orchards and packing houses, the evenings being spent in traveling and writing up notes. The orchards and packing houses in the vicinity of the following towns were studied: Fresno, Lindsay, Porterville, San Bernardino, Redlands, Highland, Riverside, Corona, Upland, Ontario, San Dimas, Covina, Glendora, Alhambra, Altadena, Whittier, Los Angeles, Fullerton, Orange, Santa Ana, San Diego, Chula Vista, Lemon Grove, San Fernando, Santa Paula and Santa Barbara.

The fruit growers in the sections visited took a keen interest in the course and did a great deal to facilitate the work. This spirit of cordial coöperation and generous assistance is highly appreciated by the students and the professor in charge. The entire expense of the course was borne by the students and averaged about one hundred and fifty-five dollars each for fees and traveling expenses.

Soil Mapping Course.—The summer course in Soil Surveying consisted of six weeks' field work, three weeks at the University Farm at Davis, and three weeks on the Kearney Ranch, near Fresno. At each place a tract of land was surveyed by the students. A base map was constructed, using the plane table traverse methods that are used by the Geological Survey and Soil Survey of the Federal Government. Borings were made in the field, the soils examined carefully, and the types recognized were plotted on the maps in different colors. Reports covering the character of the soil, the crop adaptations, drainage, alkali, etc., were prepared by each student.

In addition to this field work, trips were taken over the surrounding country, studying the general soil and crop conditions. Full notes were taken on these trips and the conditions seen were discussed in informal meetings.

The students showed marked interest in the work and turned in reports that showed that they had comprehended the difference in soil classification and crop adaptation, and had grasped the problems that were encountered.

Correspondence Instruction in Agriculture.—The College of Agriculture has undertaken correspondence courses designed for farmers or those expecting to live on the farm who desire specific and detailed information regarding the production of certain crops or animals.

The correspondence courses are designed to give specific information, rather than to deal with generalized considerations of agriculture. For instance, instead of offering a course in animal husbandry, courses in swine, dairy and poultry husbandry, etc., are being prepared, each course being complete in itself and containing information that a man making a specialty of any one of these respective branches should know. Instead of offering a course in crop production or horticulture, specific and detailed instruction on potato or alfalfa growing, or apple or walnut culture will be available.

A single lesson does not exceed twelve double-spaced typewritten pages in length, when no reference reading is required. When textbooks or bulletins are used, the lessons are reduced to about six pages.

Each lesson is accompanied by an examination sheet containing questions that bear directly upon the particular lesson or assignment and special topics for discussion designed to develop the special problems of the individual student.

The number of lessons or assignments necessary to complete a given topic varies from eight to eighteen.

The lessons are practical and easy to understand, being written with the assumption that the student has little knowledge of the subject treated. It has been borne in mind that textbooks were designed for the teacher as well as for the student. In correspondence instruction, the teacher is absent, therefore the method of presentation must be different. There will be a thorough examination and correction of the written work of the students as well as full, clear, and exact written explanation of all difficulties met with by students.

The subjects mentioned below are now in course of preparation, representing as they do the most important specialized agricultural industries in this state:

Alfalfa culture
Bean culture
Corn culture
Potato culture
Onion culture
Wheat culture
Oat culture
Barley culture
Rice culture

Apple culture
Pear culture
Peach culture
Plum culture
Cherry culture
Walnut culture
Almond culture
Grape culture
Olive culture
Fig culture
Citrus fruits

Dairy husbandry
Swine husbandry
Sheep husbandry
Beef husbandry
Poultry husbandry
Bee keeping
Floriculture
Landscape gardening
Rural Public Health

Boys and Girls' Club Work.—During the present year boys and girls' clubs have been organized in twenty-six counties. It has not been possible to learn the exact number of clubs or of boys and girls reached through the clubs. The boys and girls' club work may be said to have had its inception at a meeting of the State Association of City and County Superintendents, at Santa Catalina Island, in August, 1912, though Mr. C. A. Stebbins, connected with the Agricultural Education Division from 1910 to July, 1912, had done some work in the promotion of gardening in elementary schools through an organization known as the "California Junior Gardeners."

A conference was held at Santa Catalina regarding the possibilities in the way of boys and girls' club work for California elementary and grammar schools.

As a result, the advantages of such work were agreed upon, and the advisability of utilizing agricultural and domestic science clubs as a factor in elementary education and as a socializing and educative influence in school communities was made clear. The superintendents were encouraged to start the organization of the clubs in the schools in their respective counties and were informed that the division of Agricultural Education would be glad to do everything possible to assist them in promoting the work and usefulness of the clubs.

By coöperation between the state and county superintendent of schools, state and county fair officials, and this department there is no doubt that an excellent system of club work can be devised and put in operation. That the results will be worth while seems sure. Whereever boys and girls' club work has been wisely organized throughout a state it has not only proved of value to individual boys and girls and as an aid in agricultural instruction, but it has been an effective and wholesome method of inciting a keener interest in the affairs of scientific agriculture among adults. It has, to a greater or less degree, an inevitable influence upon the work of adult farmers. The father can not help catching some of the enthusiasm of the boy when he sees the value of better farming methods demonstrated to him.

Ease in administration of club work can be secured by making the county the unit for contest work. This will also make possible a variety in the nature of the contests, so that the children can engage in those activities of greatest local importance. The club work of other states affords many examples of "sufficient incentive" in the way of awards, which we may profit by in developing the work. Trips to the State Agricultural College, to the University Farm School, to the State Fair, or to a Boys or Girls' Camp, have all proved popular as the highest award for a county. Lesser awards, significant in character, can readily be arranged for winners of local contests. Exhibition of prize products of each club at the county fair, exhibits at the state fair, etc., are legitimate means of popularizing and adding interest to the work.

Seed Distribution.—As a part of the extension work for schools the seed exchange of previous years was continued through 1912–1913. Miss Jones was in charge of this work and reports a total of 218 seed packets sent out during the year, to twenty different schools. In connection with this work suggestions were made and advice given, where requested, as to the choice of plants and as to planting plans for school grounds, home grounds, etc. Lists of vines suitable for use in different parts of California, a list of plants that grow well in the shade, and a list of drought resistant plants were also prepared in response to inquiries.

Agriculture in California Schools.—During the past year agriculture was taught in fifty-one high schools of the state, the courses varying from one to four years in length. In response to letters sent to the fifty-eight county superintendents in the state regarding the present status of agricultural instruction in the elementary and grammar schools, thirty-six replies were received. Six superintendents reported that agriculture was not being taught in their schools, the reasons being that severity of climate or non-agricultural districts naturally eliminated the subject from the schools. One superintendent did not favor the introduction of agriculture in the grammar grades until it could be properly taught, which he did not consider possible under his present conditions and with his present teachers. He thought club and contest work would meet his requirements best for the present. Eleven counties reported that their schools were required to offer agriculture as a subject in the seventh and eighth grades. This work in most instances consisted merely in one or two terms of reading of some prescribed text. In a few counties the course is outlined in the county manual which the teachers are expected to follow more or less closely.

School garden work is reported in twenty-eight counties and it is being given in four or five other counties that did not report.

Respectfully submitted,

THOMAS F. HUNT.

STATION PUBLICATIONS AVAILABLE FOR DISTRIBUTION

REPORTS

*1896. Report of the Viticultural Work during the seasons 1887-93, with data regarding the Vintages of 1894-95.
1897. Resistant Vines, their Selection, Adaptation, and Grafting. Appendix to Viticultural Report for 1896.
1902. Report of the Agricultural Experiment Station for 1898-1901.
1903. Report of the Agricultural Experiment Station for 1901-03.
1904. Twenty-second Report of the Agricultural Experiment Station for 1903-04.

BULLETINS

No.
Reprint. Endurance of Drought in Soils of the Arid Region.
128. Nature, Value, and Utilization of Alkali Lands, and Tolerance of Alkali. (Revised and Reprint, 1905.)
133. Tolerance of Alkali by Various Cultures.
*147. Culture Work of the Sub-stations.
*162. Commercial Fertilizers. (Dec. 1, 1904.)
164. Poultry Feeding and Proprietary Foods.
*165. Asparagus and Asparagus Rust in California.
*167. Manufacture of Dry Wines in Hot Countries.
168. Observations on Some Vine Diseases in Sonoma County.
169. Tolerance of the Sugar Beet for Alkali.
170. Studies in Grasshopper Control.
171. Commercial Fertilizers. (June 30, 1905.)
174. A New Wine-Cooling Machine.
*176. Sugar Beets in the San Joaquin Valley.
177. A New Method of Making Dry Red Wine.
178. Mosquito Control.
179. Commercial Fertilizers. (June, 1906.)
181. The Selection of Seed Wheat.
182. Analysis of Paris Green and Lead Arsenic. Proposed Insecticide Law.
183. The California Tussock-moth.
184. Report of the Plant Pathologist to July 1, 1906.
185. Report of Progress in Cereal Investigations.
186. The Oidium of the Vine.
187. Commercial Fertilizers. (Jan., 1907.)
*188. Lining of Ditches and Reservoirs to Prevent Seepage Losses.
189. Commercial Fertilizers. (June, 1907.)
*191. California Peach Blight.
192. Insects Injurious to the Vine of California.
194. Commercial Fertilizers. (Dec., 1907.)
195. The California Grape Root-worm.
197. Grape Culture in California; Improved Methods of Wine-making; Yeast from California Grapes.
198. The Grape Leaf-Hopper.
199. Bovine Tuberculosis.
201. Commercial Fertilizers. (June, 1908.)
202. Commercial Fertilizers. (Dec., 1908.)

No.
203. Report of the Plant Pathologist to July 1, 1909.
204. The Dairy Cow's Record and the Stable.
205. Commercial Fertilizers. (Dec., 1909.)
206. Commercial Fertilizers. (June, 1910.)
207. The Control of the Argentine Ant.
208. The Late Blight of Celery.
209. The Cream Supply.
210. Imperial Valley Settler's Crop Manual.
211. How to Increase the Yield of Wheat in California.
212. California White Wheats.
213. The Principles of Wine-making.
214. Citrus Fruits Insects.
215. The House Fly in its Relation to Public Health.
216. A Progress Report upon Soil and Climatic Factors Influencing the Composition of Wheat.
217. Honey Plants of California.
218. California Plant Diseases.
219. Report of Live Stock Conditions in Imperial County, California.
220. Fumigation Studies No. 5; Dosage Tables.
*221. Commercial Fertilizers. (Oct., 1911.)
222. The Red or Orange Scale.
223. The Black Scale.
224. The Production of the Lima Bean.
225. Tolerance of Eucalyptus for Alkali.
226. The Purple Scale.
227. Grape Vinegar.
*228. Pear Thrips and Peach Tree Borer.
*229. Hog Cholera and Preventive Serum.
230. Enological Investigations.
*231. Walnut Culture in California. Walnut Blight.
232. Commercial Fertilizers.
233. Three Years' Work of the Ferndale (Humboldt County) Cow Testing Association.
234. Red Spiders and Mites of Citrus Trees.
235. Further Proof of the Cause and Infectiousness of Crown Gall.
236. The Economic Value of the Western Meadowlark in California.
237. Pork Production under California Conditions.
*238. The Selective Improvement of the Lima Bean.
239. The Culture of Tomatoes in California, with Special Reference to Their Diseases.

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* Edition exhausted.

CIRCULARS

No.
*1. Texas Fever.
*7. Remedies for Insects.
9. Asparagus Rust.
*11. Fumigation Practice.
29. Preliminary Announcement Concerning Instruction in Practical Agriculture upon the University Farm, Davis, Cal.
46. Suggestions for Garden Work in California Schools.
52. Information for Students Concerning the College of Agriculture.
55. Farmers' Institutes and University Extension in Agriculture.
*60. Butter Scoring Contest, 1910.
61. University Farm School.
62. The School Garden in the Course of Study.
63. How to Make an Observation Hive.
65. The California Insecticide Law.
66. Insecticides and Insect Control.
*67. Development of Secondary School Agriculture in California.
68. The Prevention of Hog Cholera.
69. The Extermination of Morning-Glory.
70. Observation of the Status of Corn Growing in California.
74. Rice.
75. A New Leakage Gauge.
76. Hot Room Callusing.
77. University Farm School.
78. Announcement of Farmers' Short Courses for 1912.
79. List of Insecticide Dealers.
80. Boys' and Girls' Clubs.

No.
81. Sweet Pea Growing Clubs.
82. The Common Ground Squirrels of California.
83. Potato Growing Clubs.
84. Mushrooms and Toadstools.
85. A Preliminary Report of a Nematode Observed on Citrus Roots and its Possible Relation with the Mottled Appearance of Citrus Trees.
86. Olives in California.
87. Alfalfa.
88. Advantages to the Breeder in Testing his Pure-bred Cows for the Register of Merit.
89. Hog Cholera and its Prevention.
90. Tuberculosis in Cattle and Hogs.
91. Disinfection on the Farm.
92. Infectious Abortion and Sterility in Cows.
*93. Bean Growing Clubs.
94. The Dairyman's Relation to Quality.
95. Detecting Dairy Losses.
96. Pork Production.
97. Increasing Dairy Profits.
98. Plowing and Cultivating Soils in California.
99. Hatching and Rearing of Chicks.
100. Pruning Frosted Citrus Trees.
101. Codling Moth Control in the Sacramento Valley.
102. The Woolly Aphis.
*103. Chemical Analyses of Waters.
104. The Amended Insecticide Law.
105. Analyses of Insecticides for Users.

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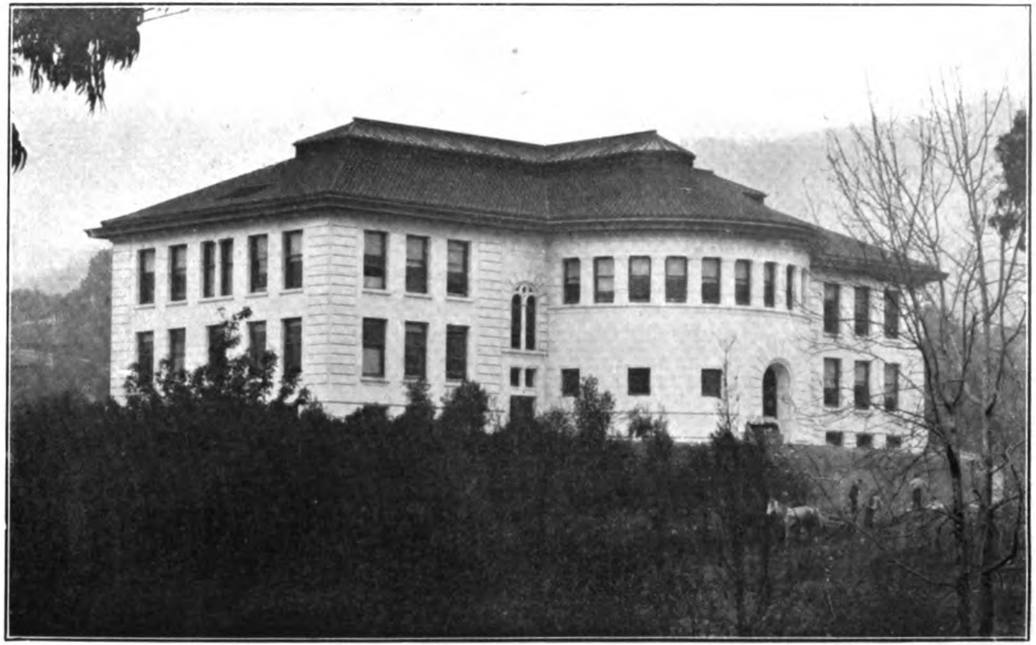

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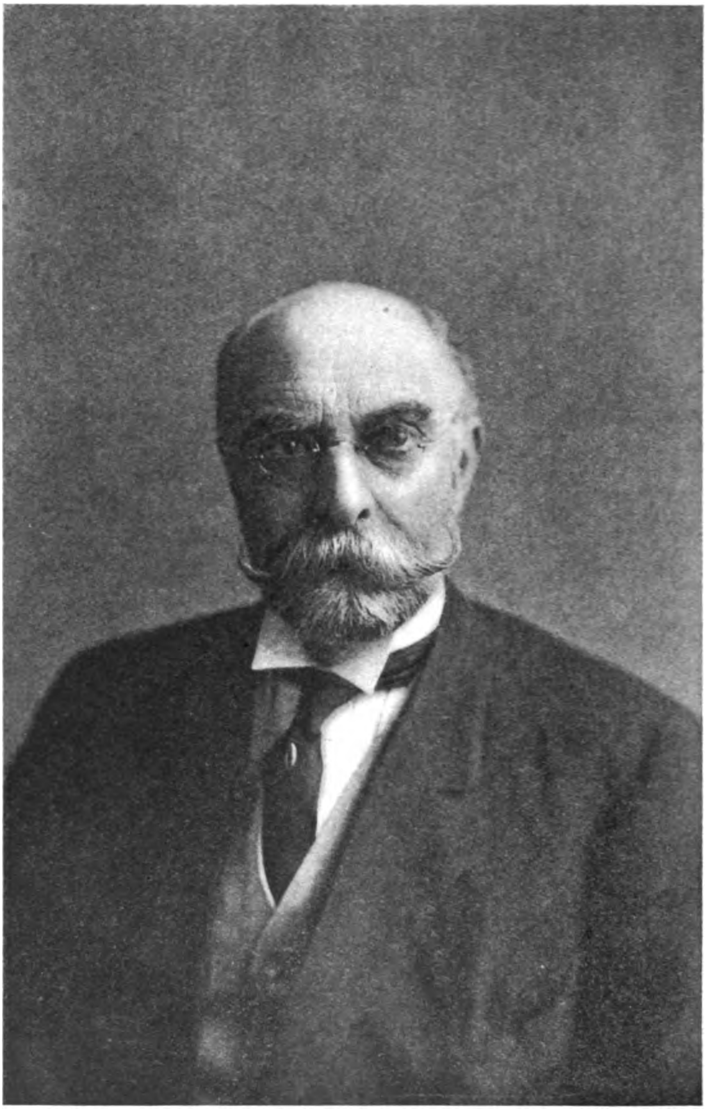

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REPORT OF THE DIRECTOR

To the President of the University of California;

Sir:—In submitting to you the work of the Department of Agriculture of the University of California for the year ending June 30, 1914, it seems desirable to emphasize the motives and purposes which have guided the members of the staff. The founders of the Smithsonian Institution, established at Washington, D. C., in 1846, declared their purpose to be the creation and diffusion of knowledge. It was not to be judicial, legislative, nor executive. Thus a new function of national import was created. In like manner it is the purpose of the Department of Agriculture of the University of California to discover and instruct, but not to control nor direct. The Department seeks to find the truth as it relates to agricultural methods and processes and by various means of education to instruct as many persons as possible in the results of research obtained by this and other agricultural experiment stations. Its means of education may be divided into two groups: internal and external.

INTERNAL INSTRUCTION

The internal instruction of the Department of Agriculture may be divided into four types: (1) Post-graduate instruction leading to a master's or doctor's degree, which may be taken at Berkeley, Davis, Riverside, Whittier, or El Centro. (2) Undergraduate instruction leading to a bachelor's degree and requiring four years, which may be taken at Berkeley or in part at Berkeley and in part at Davis. Students may major in seventeen groups of subjects. (3) University Farm School instruction at Davis, for which a certificate is given at the completion of three years' work. (4) Short course instruction of six weeks at Davis, occurring usually in October and November, and open to all persons over eighteen years of age, without academic requirements. During the year, 1913–14, the attendance upon these several types of instruction has been as follows:

(1) Post-graduate	24
(2) Undergraduate	552
(3) University Farm School	210
(4) Short courses	134

The following table shows the instruction given to undergraduate students by the several divisions of the Department of Agriculture:

	First Semester			Second Semester		
Subject	Completed	Withdrew	Total	Completed	Withdrew	Total
Agricultural Chemistry	100	9	109	25	1	26
Agricultural Education	25	....	25	43	1	44
Agriculture	108	18	126	13	1	14
Agronomy	179	22	201	125	7	132
Animal Husbandry	23	1	24	115	6	121
Citriculture	59	2	61	58	5	63
Dairy Industry	11	3	14	28	2	30
Entomology	166	25	191	399	68	467
Parasitology	117	8	125	17	....	17
Landscape Gard. and Floricul.	28	3	31	113	5	118
Genetics	16	....	16	38	1	39
Horticulture	5	....	5	234	46	280
Nutrition	301	53	354	235	32	267
Plant Pathology	54	3	57	63	4	67
Pomology	88	5	93	69	3	72
Soils	94	12	106	124	8	132
Veterinary Science	9	2	11	35	4	39
Viticulture and Enology	31	6	37	55	6	61
Farm Mechanics	......	....	......	46	1	47
Forestry	......	....	......	48	3	51
Poultry Husbandry	......	....	......	11	1	12
Scientific Illustration	......	....	......	10	....	10
Irrigation Practice	......	....	......	22	....	22
			1586			2131

There has been a marked betterment in the standard of instruction in the Department of Agriculture during the year. This has been due to a decided increase in the subject matter offered, to more extended laboratory facilities, and to an insistence that the student shall make adequate preparation for his daily tasks. The courses of study have been amplified and standardized and brought into harmony with the best traditions of university life. The announcement of graduate courses of study in agriculture is much more complete than has heretofore been attempted. The contribution to the summer session by the several divisions of the Department has been most hearty and gratifying in view of the fact that no additional stipend is given for this work. Fourteen summer practice courses have been organized to meet the needs of students, who have completed the sophomore year, for practical experience along the line of their major work. University instruction at the University Farm has been developed both along scientific and practical lines. The work continues to grow in popularity to such an extent that the 61 University students who were in residence there this semester have petitioned unanimously that University instruction be provided throughout the year in place of merely in the second half-year as at present. For financial and other reasons, it was necessary to deny this petition, but probably the time will soon come when it will be necessary to provide such work throughout the year, not only for the purpose of increasing its efficiency but also to relieve the pressure at Berkeley. For discussion of instruction at the University Farm School see page 52.

EXTERNAL INSTRUCTION

The forms of external instruction are extremely varied. They consist of the distribution of reports, bulletins, and circulars of the Agricultural Experiment Station, of which about 425,000 copies have been distributed during the year; of correspondence instruction, numbering 8833 individuals; and a voluminous correspondence in answer to inquiries. There have been written by members of the staff during the year ending June 30, 1914, 67,417 letters, not including the acknowledgment of requests for bulletins or corrections of correspondence lessons. Soil samples to the number of 2200 have been examined relative to alkali or plant food content and report rendered as to adaptability for crops or methods of tillage and fertilization.

Farmers' Institutes, movable schools, agricultural clubs, exhibits at fairs, personal visits to farms, are all used by the Extension Division in carrying the discoveries of the Station to the people. The Extension Division estimates that it has reached, through these agencies, not excluding duplicates, 175,000 persons during the present year.

A system of farm advisers or county agents has been started, creating the most direct method of bringing the man or woman on the land in personal touch with the work of the Station. Farm advisers have been established in Humboldt, San Diego, Yolo, and San Joaquin Counties, while the following counties have made the necessary appropriations and are awaiting the appointment of a farm adviser: Madera, Ventura, Napa, Alameda, Kern, and Solano. These additional advisers have been made possible, by the United States Congress, by the passage of the Smith-Lever Act, copy of which will be found in the appendix of this report. Since the creation of the system of farm advisers illustrates the function of the Department to discover and instruct or advise, the organization of the farm adviser system will be described briefly.

No farm adviser in California is placed in any county until the people of that county, through their own initiative, ask for it. The University offers to appoint and pay the salary of a farm adviser only after the Board of Supervisors has appropriated $2000 for the annual expenses of the adviser and there has been organized a farm bureau of at least one-fifth the farmers of the county with an annual membership of one dollar. The farm adviser is required to serve any farmer of the county, whether a member of the bureau or not, but he is instructed not to visit any farm unless he is invited to do so. The purpose of the farm bureau is first to demonstrate whether the farm adviser is really wanted by the farmers themselves, and second to create an efficient working agency, as explained in Circular No. 118 of this Station. The farm adviser does not seek to control or direct the action of any person. He gives to each person the best advice of which he is capable through the aid of the staff of the Agricultural Experiment Station, but the initiative still rests with the person seeking the advice. If, for the successful prosecution of the methods advised, it is necessary to have concerted action, or if it is necessary to pass and execute laws, the people themselves must take the next necessary steps; or the legislative and executive branches of the Government must create and execute such measures as the investigations of the Station show to be warranted by the facts.

In the same manner the State Board of Control arranged with the President of the University to have this Department examine into the farming operations of the various state institutions. During the month of April, 1914, the Director of the Station, with two other members of the staff, visited, examined into, and has prepared reports about the agricultural aspects of the following institutions and properties:

Mendocino State Hospital; located at Talmage, 3 miles from Ukiah.
Sonoma State Home; located at Eldridge, Sonoma County.
Napa State Hospital, Napa County.
Veterans' Home, Yountville.
Frye Ranch, near Yountville, Napa County.
San Quentin Prison, San Quentin.
Preston School of Industry, Waterman, near Ione.
Folsom Prison, Represa.
Stockton State Hospital, Stockton.
Agnews State Hospital, Agnews.
California School for Girls, Ventura.

Whittier State School, Whittier.
New State Hospital Site, Norwalk, 5 miles from Whittier.
Southern California State Hospital, Patton, San Bernardino County.

The purpose of these visits was to so acquaint members of the staff with the physical and business aspects of the agricultural operations that they will be able to give the officers of the several institutions such advice as they may, from time to time, desire. It is perhaps needless to remark that the Department of Agriculture of the University does not accept any responsibility for the conduct of the agricultural affairs of the several institutions. This Department stands in just the same relation to them as it does to every person in California who is seeking to create wealth from the soil. Each has the privilege of seeking and receiving, without charge, any information or advice which the Station is capable of giving.

Since technical advice is given alike to all persons desirous of creating wealth from the soil, there is no significance to be attached to the fact that some member of the staff has advised a particular person or firm concerning his or its operations. In giving information regarding the growing of crops or the rearing of animals, members of the staff do not assume any responsibility or necessarily vouch for the commercial aspect of any enterprise. The department will not assist in the exploitation or sale of property.

Ministers' week, held at the University Farm, Davis, December 1–5, 1913, was attended by 489 clergymen actually in charge of churches, six theological students, four missionaries, and two laymen.

Ministers' Week is another illustration of a method of diffusing knowledge relating to agriculture. Through the suggestion to the President of the University by the Rev. F. I. Drexler, a Baptist Minister at Willows, California, a course of seventy-five lectures and demonstrations was given at the University Farm at Davis, December 1 to 5, 1913, which was attended by 489 clergymen actually in charge of churches. There were in addition six theological students, four missionaries and two laymen, making a total attendance of 501. Forty-nine counties and eighteen denominations were represented. There are said to be 2600 clergymen in California. Presumably half or more of them have their pastorates in the larger cities.

The purpose of this course of lectures was not intended to make clergymen into farmers. Its purpose was to acquaint clergymen with the agricultural problems and practices of their times so they may be intelligently informed on the business of their people. This is by no means the first time that rural ministers have come together for a conference. It is believed, however, that the point of view of this programme is sufficiently unique to justify its publication:

MONDAY, DECEMBER 1

7:30–10:00 P.M.
  "Get-together Meeting."
  "Address of Welcome."
    By Dean H. E. Van Norman.
  "Response."
    By Rev. F. I. Drexler, Pastor Baptist Church, Willows, Calif. Followed by informal reception of visitors by faculty and students of the Farm School.

TUESDAY, DECEMBER 2

8:00–9:00 A.M.
  "Judging Beef Cattle."
    Demonstration by Mr. V. R. Dolcini.

9:00–10:00 A.M.
  "Grapes in California."
    Lecture by Professor F. T. Bioletti.
  "Selecting a Poultry Farm."
    Lecture by Professor J. E. Dougherty.
  "The Formation of Soils."
    Lecture by Professor C. F. Shaw.
  "Irrigation Resources of California."
    Lecture by Mr. Frank Adams, U. S. Department of Agriculture.

10:30–11:30 A.M.
  "Building a Poultry House."
    Lecture by Professor J. E. Dougherty.

"The Soil Survey of California."
Lecture by Professor C. F. Shaw.
"Fundamental Principles of Plant Breeding."
Lecture by Professor E. B. Babcock.
"Economic Importance of Plant Diseases."
Lecture by Professor W. T. Horne. Illustrated by lantern slides.

1:00–2:00 P.M.
"Irrigation Investigations."
Lecture by Mr. S. H. Beckett. Illustrated by lantern slides.
"The Feeding of the Laying Hen."
Lecture by Professor J. E. Dougherty.
"Citriculture."
Lecture by Professor J. E. Coit. Illustrated by lantern slides.
"The Ministers' Interest in Plant Breeding."
Lecture by Professor E. B. Babcock. Illustrated by lantern slides.

2:30–5:30 P.M.
Inspection of rural schools to observe improvements made.
Field Trip—Professors W. G. Hummel and O. J. Kern.

3:30–4:30 P.M.
"Budding, Grafting and Making Cuttings."
Demonstration by Mr. R. H. Taylor.

4:00–5:00 P.M.
"Pruning Methods with Grapes."
Demonstration by Professor F. T. Bioletti.

7:30–10:00 P.M.
"What the Country Life Movement Means."
Address by Dean Thomas Forsyth Hunt.
"What the County Work Strives to Do."
Address by Mr. Wm. D. McRae, State County Work Secretary, Y. M. C. A.
"What this Movement Means to the Metropolis."
Address by Mr. Robert Newton Lynch, California Development Board.

WEDNESDAY, DECEMBER 3

8:00–9:00 A.M
"Pickling Methods with Olives."
Demonstration by Mr. W. F. Oglesby.
"Judging Mutton Sheep."
Demonstration by Mr. C. R. George.

9:00–10:00 A.M.
"Fruit Handling and Storage."
Lecture by Professor B. B. Pratt.
"Incubation and Brooding of Poultry."
Lecture by Professor J. E. Dougherty.
"Rural Hygiene and Sanitation."
Lecture by Professor W. B. Herms. Illustrated by lantern slides.

10:30–11:30 A.M.
"Selection of Orchard Locations."
Lecture by Professor B. B. Pratt.

"What are the Factors of Successful Farming?"
Lecture by Professor J. W. Gilmore.
"Conservation of Health on the Farm."
Lecture by Professor W. B. Herms. Illustrated by lantern slides.
"How the Food and Drug Regulation Effects the Consumer."
Lecture by Professor M. E. Jaffa. Illustrated by lantern slides.

1:00–2:00 P.M.
Round Table Discussion—"Social Activities of the Rural Church."
Professor B. H. Crocheron, Chairman.

2:00–3:00 P.M.
"Food as Preventive Medicine."
Lecture by Professor M. E. Jaffa.
"Olives in California."
Lecture by Mr. W. F. Oglesby.
"Agriculture in Relation to National Welfare."
Lecture by Professor J. W. Gilmore.
"Community Work in Rural Schools."
Lecture by Professor W. G. Hummel. Illustrated by lantern slides.

3:30–4:30 P.M.
"Pruning a Young Orchard."
Demonstration by Professor B. B. Pratt.
"Administration of Anti-hog Cholera Serum."
Demonstration by Dr. F. M. Hayes.

4:30–6:00 P.M.
"Mixing Lime-Sulphur."
Demonstration by Mr. Leslie J. Nickels.

7:30–10:00 P.M.
"Country Communities and Social Life."
Address by Acting President D. P. Barrows.
"Relation of Educational Work to the Farm."
Address by Judge Peter J. Shields.
"Results from the Rural Church Surveys."
Address by Dr. Warren H. Wilson, Superintendent, Department Church and Country Life Board of Home Missions, Presbyterian Church.

10:00 P.M.
Injection of Cow in Application of Tuberculin Test.

THURSDAY, DECEMBER 4

8:00–9:00 A.M.
"Judging Hogs."
Demonstration by Mr. V. R. Dolcini.
"Irrigation Methods."
Demonstration by Mr. S. H. Beckett.

9:00–10:00 A.M.
"Socializing of the Country School."
Lecture by Professor O. J. Kern. Illustrated by lantern slides.
"Ornamentation of Home Grounds."
Lecture by Professor J. W. Gregg. Illustrated by lantern slides.
"Selection of the Dairy Cow."
Demonstration lecture by Dean H. E. Van Norman.

10:30–11:30 A.M.
"Agricultural Education in the Country."
Lecture by Professor O. J. Kern. Illustrated by lantern slides.
"School Ground Development."
Lecture by Professor J. W. Gregg. Illustrated by lantern slides.
"Care and Handling of Milk."
Lecture by Professor L. M. Davis.
"Nature and Study of Plant Diseases.
Lecture by Professor R. E. Smith. Illustrated by lantern slides.

12:45 P.M.
"Observation of Tuberculin Test in progress.

1:00–2:00 P.M.
Round Table Discussion—"The Clergyman's Part in Rural Organization."
Professor B. H. Crocheron, Chairman.

2:00–3:00 P.M.
"The Situation with Regard to California Forage Plants and Grasses."
Lecture by Professor E. J. Wickson.
"Plant Materials"—a discussion of the most common plants that may be used for home and school decoration.
Lecture and Inspection Trip by Professor R. T. Stevens.
"Conserving the Soil Moisture."
Lecture by Professor C. F. Shaw.
"Cow-testing Associations."
Lecture by Dean H. E. Van Norman.

3:30–4:30 P.M.
"Operation of Hand Separators."
Demonstration by Professor L. M. Davis.

4:30–6:00 P.M.
"Incubation Methods with Poultry."
Demonstration by Professor J. E. Dougherty.
Finish of Tuberculin Test with slaughter of reacting cow.
Demonstration by Dr. C. M. Haring.

7:30–10:00 P.M.
"How are Young Men to Become Farmers?"
Address by Dean Thomas Forsyth Hunt.
"What Can be Done to Improve the Human Race."
Address by Director H. J. Webber.
"Organization of the Rural Church."
Address by Dr. Warren H. Wilson.

FRIDAY, DECEMBER 5

8:00–9:00 A.M.
"Judging Draft Horses."
Demonstration by Professor G. H. True.

9:00–10:00 A.M.
"Parasites."
Lecture by Professor C. W. Woodworth. Illustrated by lantern slides.

"Chemical Relations of Soil Fertility."
Lecture by Professor C. B. Lipman. Illustrated by lantern slides.
"Control of Plant Diseases."
Lecture by Mr. S. S. Rogers. Illustrated by lantern slides.

10:30–11:30 A.M.
"Spraying."
Lecture by Professor C. W. Woodworth. Illustrated by lantern slides.
"Semi-tropical Pomology."
Lecture by Professor J. E. Coit. Illustrated by lantern slides.
"Irrigation Methods and Practice in California."
Lecture by Professor B. A. Etcheverry. Illustrated by lantern slides.

1:00–2:00 P.M.
Round Table Discussion—"Heredity as a Factor in the Rural Community."
Prof. B. H. Crocheron, Chairman.

2:00–3:00 P.M.
"Bacterial Relations of Soil Fertility."
Lecture by Professor C. B. Lipman.
"Irrigation Institutions in California."
Lecture by Mr. A. E. Chandler.
"Building up a Dairy Herd."
Lecture by Professor G. H. True.
"Fighting Disease on the Farm."
Lecture by Professor W. B. Herms.

3:30–6:00 P.M.
"An Inspection of Soil Conditions near Davis."
Field Trip—Professor C. F. Shaw.

3:30–4:30 P.M.
"Pruning an Old Orchard."
Demonstration by Professor B. B. Pratt.

4:30–5:30 P.M.
"House Fumigation."
Demonstration by Professor C. W. Woodworth.

7:30–10:00 P.M.
"Extension Work in the College of Agriculture."
Address by Professor W. T. Clarke.
"The County Farm Adviser and his Work."
Address by Professor B. H. Crocheron.
"The Social Economics of Agriculture."
Address by Professor C. H. Parker.

No member of the staff of the Department of Agriculture sought to discuss with the clergymen their problems, but aimed to give them an intelligent conception of the agricultural problems of their communities. Such men, however, as Dr. Warren H. Wilson, and others, spoke on the pastor's opportunities and responsibilities and a Round Table was conducted each afternoon, where the ministers discussed their own problems. The railroads of California furnished transportation to ordained ministers actually in charge of churches,—as is permitted by law, and the University Farm furnished living accommodations. The purpose of this series of lectures was not, of course, primarily to help ministers, but for the purpose of using one of the most effective agencies in the state for carrying to the people a knowledge of the broader problems of agriculture.

Although less unique, the California Fruit Growers' Convention was held at the University Farm, Davis, California, from June 1st to 6th, 1914, under the auspices of the State Commissioner of Horticulture, Dr. A. J. Cook, the Yolo County Board of Trade, and the College of Agriculture, University of California. There were many notable addresses among the 220 given, twelve persons coming from outside the state for the purpose. There were 791 registrations, and it is believed that well beyond a thousand persons were in attendance.

There have been many other meetings and conferences by associations and groups of people, including the Horticultural Assembly at Riverside on November 15, 1913, with an attendance of about 600; a conference of Veterinarians at Berkeley on July 11 and 12, 1913, on the subject of Tuberculosis in Domestic Animals, at which Dr. Veranus A. Moore, Dean of New York State Veterinary College at Cornell University, and Dr. M. P. Ravenel, Professor of Hygiene, University of Wisconsin, were present. During the year the following associations held meetings at the University Farm at Davis:

Swine Breeders' Association	November 7, 1913
Ministers' Week	December 1 to 5, 1913
District Library Meeting	March 14, 1914
Women's Clubs—Northern District	April 2, 1914
Horse Breeders' Association	May 16, 1914
Fruit Growers' Convention	June 1 to 6, 1914
Swine Breeders' Association	June 2, 1914

INVESTIGATIONS

It must be patent to everyone that if the Department of Agriculture assumes, in a state with the varied resources of California, the responsibility of giving advice to all seeking it, it has a somewhat herculean task. The Land Grant Act of 1862 provided, among other things, for the teaching of agriculture in an institution of college grade. At the end of a couple of decades it became apparent that in order to teach agriculture successfully there must be some accurate knowledge of agriculture to teach. This led to the Hatch Act of 1888, establishing the Agricultural Experiment Stations of the country, and to the Adams Act in 1906 for their further development. In view of the recent action of Congress in passing the Smith-Lever Bill, the several Acts of the Federal Congress, which affect by appropriation the work of the College of Agriculture, are stated below:

1. The Land Grant Act, or Morrill Act

Public Laws of the United States, 1862, Chapter 130

(Approved by President Lincoln, July 2, 1862)

An Act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts, granting to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State a quantity equal to thirty thousand acres for each Senator and Representative in Congress to which the States are respectively entitled by the apportionment under the Census of 1860: Provided, That no mineral lands shall be selected or purchased under the provisions of this act.

II. Congressional Industrial Fund, or Second Morrill Act

(Approved by President Harrison, August 30, 1890)

An Act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts established under the provisions of an act of Congress approved July second, eighteen hundred and sixty-two, annually appropriating, out of any money in the Treasury not otherwise appropriated, arising from the sales of public lands, to be paid as hereinafter provided, to each State and Territory for the more complete endowment and maintenance of colleges for the benefit ot agriculture and the mechanic arts now established or which may be hereafter established, in accordance with an act of Congress approved July second, eighteen hundred and sixty-two, the sum of fifteen thousand dollars for the year ending June thirtieth, eighteen hundred and ninety, and an annual increase of the amount of such appropriation thereafter for ten years by additional sum of one thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and Territory shall be twenty-five thousand dollars to be applied only to instruction in agriculture, the mechanic arts, the English language and the various branches of mathematical, physical, natural and economic science, with special reference to their application in the industries of life and to the facilities for such instruction.

III. The Hatch Act, or Experiment Station Act

(Approved by President Cleveland, March 2, 1887)

An Act to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July second, eighteen hundred and sixty-two, and of the acts supplementary thereto, appropriating to each State, to be specially provided for by Congress in the appropriation from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from tne sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July and October in each year.

IV. ADAMS ACT, OR SECOND EXPERIMENT STATION ACT

(Approved by President Roosevelt, March 16, 1906)

An Act to provide for an increased annual appropriation for agricultural experiment stations and regulating the expenditure thereof, annually appropriating out of any money in the Treasury not otherwise appropriated, to be paid as hereinafter provided, to each State and Territory, for the more complete endowment and maintenance of agricultural experiment stations now established or which may hereafter be established in accordance with the Act of Congress approved March second, eighteen hundred and eighty-seven, the sum of five thousand dollars in addition to the sum named in said Act for the year ending June thirtieth, nineteen hundred and six, and an annual increase of the amount of such appropriation thereafter for five years by an additional sum of two thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and Territory shall be thirty thousand dollars, to be applied only to paying the necessary expenses of conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective States or Territories.

V. NELSON AMENDMENT, OR THIRD ENDOWMENT ACT

The following clause was inserted in the Act making appropriations for the United States Department of Agriculture, for the year ending June 30, 1908. (Act approved March 14, 1907):

. . . That there shall be, and hereby is, annually appropriated, out of any money in the Treasury not otherwise appropriated, to be paid as hereinafter provided to each State and Territory for the more complete endowment and maintenance of agricultural colleges now established, or which may hereafter be established, in accordance with the act of Congress approved July second, eighteen hundred and sixty-two, and the Act of Congress approved August thirtieth, eighteen hundred and ninety, the sum of five thousand dollars, in addition to the sums named in the said act, for the fiscal year ending June thirtieth, nineteen hundred and eight, and an annual increase of the amount of such appropriation thereafter for four years by an additional sum of five thousand dollars over the preceding year, and the annual sum to be paid thereafter to each State and Territory shall be fifty thousand dollars, to be applied only for the purposes of the agricultural colleges as defined and limited in the Act of Congress approved July second, eighteen hundred and sixty-two, and the Act of Congress approved August thirtieth, eighteen hundred and ninety.

SMITH-LEVER ACT

(Approved by President Wilson, May 8, 1914)

An Act to provide for co-operative agricultural extension work between the agricultural colleges in the several States receiving the benefits of an Act of Congress approved July second, eighteen hundred and sixty-two, and permanently appropriating out of any money in the Treasury not otherwise appropriated, the sum of $480,000 for each year, $10,000 of which shall be paid annually, in the manner hereinafter provided, to each State which shall by action of its legislature assent to the provisions of this Act: Provided, That payment of such installments of the appropriation hereinbefore made as shall become due to any State before the adjournment of the regular session of the legislature meeting next after the passage of this Act may, in the absence of prior legislative assent, be made upon the assent of the governor thereof, duly certified to the Secretary of the Treasury: Provided further, That there is also appropriated an additional sum of $600,000 for the fiscal year following that in which the foregoing appropriation first becomes available, and for each year thereafter for seven years a sum exceeding by $500,000 the sum appropriated for each preceding year, and for each year thereafter there is permanently appropriated for each year the sum of $4,100,000 in addition to the sum of $480,000 hereinbefore provided: Provided further, That before the funds herein appropriated shall become available to any college for any fiscal year plans for the work to be carried on under this Act shall be submitted by the proper officials of each college and approved by the Secretary of Agriculture. Such additional sums shall be used only for the purpose hereinbefore stated, and shall be allotted annually to each State by the Secretary of Agriculture and paid in the manner hereinbefore provided, in the proportion which the rural population of each State bears to the total rural population of all the States as determined by the next preceding Federal census: Provided further, That no payment out of the additional appropriations herein provided shall be made in any year to any State until an equal sum has been appropriated for that year by the legislature of such State, or provided by State, county, college, local authority, or individual contributions from within the State, for the maintenance of the co-operative agricultural extension work provided for in this Act.

RESEARCH FUNDAMENTAL TO SUCCESS

It must be obvious to a thoughtful person that the research work of the Department of Agriculture of the University of California is fundamental to its success. Without accurate knowledge it is impossible to instruct or to advise properly. There is no warrant for an Extension Division or a Farm Adviser unless the Experiment Station, through painstaking investigations, has created knowledge that is worthy of credence. There are only two satisfactory reasons for the nation and the state's maintaining an Experiment Station: one is that it shall extend the realm of knowledge concerning agriculture; the other is that those who investigate shall have no motive to do other than discover and state the truth. The highest quality an investigator can have is the ability to be judicial. The value of the man of research to the public does not lie so much in the special technical knowledge which he possesses as in the fact that his own welfare is in no way affected by the conclusions which he reaches. During the year 198 projects have been outlined. Data have been collected and placed on file in the Director's office for 142 of these projects. It should be noted that a few of the projects outlined do not represent investigation in the strict sense of the term, but are outlined for the purpose of having a permanent record of the activity involved. A list of the projects on which progress has been made during the year follows:

No. 5. The Immunization of Calves to Tuberculosis with "Bovovaccine." By C. M. Haring and R. M. Bell reporting to C. M. Haring. Suggested June 14, 1913.

No. 7. Toxicity of Insecticides (a) Insecticide Coefficients: Accuracy of Feeding of Testing Arsenicals. By C. W. Woodworth, Berkeley.

No. 16. A Systematic Study of the Important, So-called Physiological Diseases of Plants Occurring in California. By Ralph E. Smith, S. S. Rogers, Wyatt W. Jones and A. Bonequet reporting to Ralph E. Smith; at Berkeley and various field stations; Van Nuys and Roosevelt (Internal Brown Streak of Potato); Oroville (Exanthema); Stockton and vicinity (Little Leaf). Begun July 1, 1913.

No. 24. A Study of Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California. By C. M. Haring, C. L. Roadhouse and Ralph M. Bell, reporting to C. M. Haring. Suggested June 14, 1913. At Berkeley and elsewhere in California.

No. 25. A Chemical, Biological and Physiological Study of Alkali in Soils, in its Relations with Crop Production. By L. T. Sharp, reporting to Charles B. Lipman; at Davis, Berkeley, Kearney Park. Begun August, 1913.

No. 26. A Study of the Effects of Irrigation on the Physical, Chemical and Bacteriological Condition of Imperial Valley Soils. By P. S. Burgess, reporting to Charles B. Lipman; at Berkeley and Holtville. Begun January, 1913.

No. 27. A Continuation of Past Studies on the Effects of Salts of the Heavy Metals on Plant Growth. By W. F. Gericke, reporting to Charles B. Lipman; at conservatory and laboratories at Berkeley. Begun March, 1912.

No. 28. A Continuation of Past Studies on the Lime-Magnesia Ratio for Plants, Particularly Oranges. By W. F. Gericke, reporting to Charles B. Lipman; at Berkeley. Begun August, 1911.

No. 29. Studies on Soil inoculation with Non-Symbiotic Nitrogen Fixing Bacteria on Cropped and Uncropped Soils. By P. S. Burgess, reporting to Charles B. Lipman; at conservatory and laboratory in Berkeley. Begun September, 1913.

No. 30. Fundamental Studies on the Antagonism Between Salts as Measured by Bacterial Efficiency in Soils. (Continuation of past studies). By P. S. Burgess, reporting to Charles B. Lipman. Begun December, 1908.

No. 31. Determination of the Amounts of Nitrogen Fixed by Leguminous Cover Crops in California, Particularly in Orchards. By W. F. Gericke, reporting to Charles B. Lipman, at Davis and co-operatively in other orchards. Begun November, 1913.

No. 32. A Study of the Bacterial Flora of Soils on which Dieback in Citrus Trees Occurs, to Determine Whether or not any Relation Exists Between the Bacterial Flora of the Soil and the Diseased Condition. By P. S. Burgess, reporting to Charles B. Lipman. Begun July, 1912.

No. 33. Continuation of Studies on the Bacterial Flora of California Soil Columns to Complete the Comprehensive Physical, Chemical, and Biological Studies Started Some Years Ago at this Station. By P. S. Burgess and W. F. Gericke, reporting to Charles B. Lipman, at Berkeley and various important soil regions in California. Begun December, 1908.

No. 34. Co-operative Experiments in the Control of Bovine Tuberculosis. By Ralph Bell, reporting to C. M. Haring; at Berkeley and elsewhere in California. Begun August 8, 1913.

No. 35. Toxicity of Insecticides (a) Insecticide Coefficients: Comparison of Formalin and Arsenic for Flies. By C. W. Woodworth, Berkeley.

No. 38. Toxicity of Insecticides (a) Insecticide Coefficients: Study of Action of Constant Strengths of Cyanide on Insect Eggs. By C. W. Woodworth, Berkeley.

No. 39. Toxicity of Insecticides (b) Physical Variations: Strength of Tent Material to Determine Specifications for Weavers which will Give Best Compromise Between Strength and Tightness. By C. W. Woodworth, Berkeley.

No. 40. Toxicity of Insecticides (b) Physical Variations. Study of Gas Density in Fumigation. By C. W. Woodworth, Berkeley.

No. 41. Toxicity of Insecticides (b) Physical Variations. Nozzle Testing. Construction of Formulae for Nozzle Construction to Obtain any Desired Performance. By C. W. Woodworth, Berkeley.

No. 42. Toxicity of Insecticides (b) Physical Variations. Cause of Fumigation Injury. By C. W. Woodworth, Berkeley.

No. 43. Toxicity of Insecticides (c) Specific Variation Action of Various Arsenicals on Plants and Insects. By C. W. Woodworth, Berkeley.

No. 44. Toxicity of Insecticides (c) Specific Variation. Action of Petroleum Distillates on Plants. By C. W. Woodworth, Berkeley.

No. 45. Toxicity of Insecticides (c) Specific Variation of Cyanide on Different Scale Insects. By C. W. Woodworth; at Berkeley and Southern California.

No. 47. Toxicity of Insecticides (d) Physiological Variation. Respiration Losses as a Method of Recording Physiological Disturbance Due to Insecticides. By C. W. Woodworth, Berkeley.

No. 49. Toxicity of Insecticides (d) Physiological Variation. Relation of Temperature Changes to Longevity. By C. W. Woodworth, Berkeley.

No. 50. Toxicity of Insecticides (d) Physiological Variation. Progress of Poisoning as Determined by Intervitem Staining. By C. W. Woodworth, Berkeley.

No. 51. Reclamation of Alkaline Lands by Flooding and Tile Drainage. Work done co-operatively by the Division of Soil Technology, University of California, and the Division of Drainage Investigations, Office of Experiment Stations, United States Department of Agriculture, at Fresno, California, S. E. ¼, Sec. 6, T 148, R 19 E. By C. F. Shaw and W. W. Weir, reporting to Charles F. Shaw. Begun June 9, 1913.

No. 52. Hog Cholera, its Prevalence and Prevention in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Suggested June 14, 1913.

No. 53. Concentration of Hog Cholera Serum and the Precipitation of the Immune Bodies. Work done co-operatively by J. F. Mitchell and C. H. McCharles of the Nutrition Division, reporting to C. M. Haring; at Budd Hall and Veterinary Science Laboratory. Begun June 1, 1913.

No. 54. Miscellaneous Investigations Concerning Live Stock Losses in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Suggested June 14, 1913.

No. 55. Technical Improvements in the Manufacture of Hog Cholera Serum and Virus. By J. F. Mitchell, reporting to C. M. Haring; at Veterinary Science Laboratory and Hog Serum Laboratory, Berkeley. Suggested June 14, 1913.

No. 56. Improvements in the Dosage and Administration of Hog Cholera Serum and Virus. By J. F. Mitchell, reporting to C. M. Haring. Begun July 1, 1913.

No. 57. Studies upon the Bacterial Purity of Anti-Hog Cholera Serum Produced by the Various State Stations and Commercial Firms and upon Better Methods of Preserving Our Serum. By F. M. Hayes, reporting to C. M. Haring; at Veterinary Science Laboratory. Begun June 16, 1913.

No. 58. The Determination and Significance of the Spirochaeta Present in the Blood of Hogs Infected with Hog Cholera. By F. M. Hayes, reporting to C. M. Haring, at Veterinary Science Laboratory. Begun July 25, 1913.

No. 59. A Record of the Results of Hog Cholera Immunization at the University Farm. By F. M. Hayes, reporting to C. M. Haring. Begun April, 1913.

No. 60. Experiments Concerning the Bacterial Content of Milk, Skimmilk and Cream. By C. L. Roadhouse and R. S. Adams, reporting to C. M. Haring; at Veterinary Science Laboratory and University of California Dairy. Begun August 19, 1913.

No. 61. Certified Dairy Inspections. By C. L. Roadhouse and G. K. Cooke, reporting to C. M. Haring; at various certified dairies. Suggested June 14, 1913.

No. 62. Tuberculin Testing of Cows in Certified Dairies. By C. L. Roadhouse, reporting to C. M. Haring. Suggested June 14, 1913.

No. 63. Bacteriological Examination of Certified Milk. By C. L. Roadhouse et al, reporting to C. M. Haring; at Veterinary Science Laboratory. Suggested June 14, 1913.

No. 64. Drainage of Irrigated Lands by Pumping from Sump, without Tile. By W. W. Weir and L. K. Marshall, reporting to Chas. F. Shaw. Work located at Fresno, California, Experiment Station Tract. Begun September 30, 1913.

No. 65. A Study of the Effects of Liming and Inoculating Lima Bean Soils of Santa Barbara County on the Yield and Protein Content of Lima Beans. By Charles B. Lipman. At Stow Ranch near Goleta, California, and Dixey Thompson Ranch, about four miles from Santa Barbara. Begun February 1, 1913.

No. 66. A Continuation of Studies on the Effects of Temperatures of Irrigation Water on the Development of Orange Trees. By W. F. Gericke, reporting to Charles B. Lipman; at conservatory at Berkeley. Begun July, 1911.

No. 67. Investigation of the Moisture Content and Fertilizing Value of the Principal Kelps Found on the Coast of California. By Guy R. Stewart, reporting to J. S. Burd; field work at La Jolla and the vicinity of Monterey, laboratory work at Berkeley. Suggested August 15, 1913.

No. 68. The Use of Supplemental Feed with Barley for Pork Production. By J. I. Thompson, reporting to Gordon H. True, at University Farm, Davis. Begun July 1, 1913.

No. 69. Comparison of Lard Hogs with Bacon Hogs for Production of Bacon. By J. I. Thompson, reporting to Gordon H. True, at University Farm, Davis. Begun July 1, 1913.

No. 70. A Feeding Experiment to Determine the Value of Ground Barley as a Supplement to Alfalfa in the Feeding of Dairy Cows. By E. C. Voorhies, reporting to Gordon H. True, at University Farm, Davis, Calif. Begun August 6, 1913.

No. 71. Studies in Beef Production: the Feeding of Beet Pulp with Various Supplementary Feeds. By Gordon H. True; at Bloomfield Ranch of Miller & Lux, Gilroy, California. Begun October 24, 1913.

No. 72. Studies Concerning Infectious Abortion. By W. J. Taylor, reporting to C. M. Haring, at Imperial Valley. Suggested June 14, 1913.

No. 73. Investigation to Find the Relative Values of Soy Bean Meal, Meatscrap, Buttermilk and O. P. Linseed Oil Meal as High Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty; at University Farm, Davis. Begun November 15, 1913.

No. 76. Metabolic Experiments with Young Poultry. Wheat Protein Experiments. By M. E. Jaffa and C. H. McCharles, reporting to M. E. Jaffa, Budd Hall, Berkeley. Begun August, 1913.

No. 78. Variety Trials of Grain. By W. E. Packard, reporting to J. W. Gilmore, at Imperial Valley (Experiment Station). Suggested August 25, 1913.

No. 79. Crop Production and Soil Management in Relation to Climatic Conditions in Imperial Valley. By Walter E. Packard, reporting to J. W. Gilmore, at Imperial Valley. Suggested July 28, 1913.

No. 80. Continuous Plantings and Biennial Cropping. By W. E. Packard, reporting to J. W. Gilmore, at Imperial Valley (Experiment Station). Suggested August 25, 1913.

No. 81. Rotations. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley (Experiment Station). Suggested August 25, 1913.

No. 82. Crop Production and Soil Management in Relation to Soil Type at Imperial Valley Station. By Walter E. Packard, reporting to J. W. Gilmore. Suggested July 28, 1913.

No. 84. Miscellaneous Plantings. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Suggested August 25, 1913.

No. 85. Comparison of Three Varieties of Alfalfa. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Suggested August 25, 1913.

No. 86. Culture Methods for Alfalfa when used for (1) Pasture; (2) Hay Production. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Suggested August 25, 1913.

No. 88. Veterinary Survey of Selby Smelter Zone for the Selby Smelter Commission. (In co-operation with Dr. K. F. Meyer of Pathology Department). By K. F. Meyer, C. M. Haring, and Wm. La Grange. Between Vallejo and Benicia; pathological work at Berkeley. Begun October 28, 1913.

No. 89. Walnut-Oak Hybrids: Study of a new form of Juglans Californica; Teratology in Juglans Californica; Allied Problems. By E. B. Babcock; at Berkeley, Garden Grove, and possibly other points in California. Begun March, 1908.

No. 90. A Study of the Value of Corn Silage as a Supplement to Alfalfa Hay. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Begun November 24, 1913.

No. 91. Metabolism of Fresh Milch Cows. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Suggested October 15, 1913.

No. 92. A Study of the Effects of Alfalfa as Exclusive Food in the Development of the Dairy Calf and Heifer for Dairy Purposes. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True. Suggested November 18, 1913.

No. 93. Studies in Beef Production: the Feeding of Various Grain Feeds in Connection with Alfalfa Hay for Range Steers. By Gordon H. True and F. W. Woll, reporting to Gordon H. True. At Riverside Ranch of the Western Meat Company at Lovelock, Nevada. Begun November 13, 1913.

No. 94. Breeding Experiments with Bulbous Plants. By H. E. Gilkey, reporting to E. B. Babcock; at Berkeley. Begun November, 1912.

No. 95. Studies on the Relative Availability of Nitrogenous Fertilizers for Oranges, Lemons, and Sugar Beets. By P. S. Burgess, reporting to Charles B. Lipman; at Spreckles and Oxnard for beets; the Phalanx Ranch, Exeter, for oranges; and the Spaulding Ranch, Sespe, for lemons. Begun March, 1912.

No. 96. Improvement of Bearing of Vine Varieties by Selection. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 97. Tests of New or Little Known Varieties of Vines. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 98. Resistant Stocks for Californian Vines. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 99. Effects of Early and Late Pruning of Vines. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis and elsewhere. Begun November, 1911; finished December, 1912.

No. 100. Disinfection of Roots and Cuttings with Hot Water. By F. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun March, 1911; finished May 23, 1913.

No. 103. Relation of Degree of Maturity of Grapes to Quantity and Quality of Raisins. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun August, 1913.

No. 104. Resistant Stocks for Raisin Varieties. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun 1911.

No. 105. Wine Grapes for the San Joaquin Valley. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun 1911.

No. 106. Varieties and Methods Suitable for Grape Growing in Imperial Valley. By W. E. Packard, reporting to Frederic T. Bioletti, at University Experiment Station, Meloland, Imperial County. Begun 1911.

No. 108. Coating for Cement Wine Vats. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley. Begun January, 1913.

No. 109. Amounts of Wine and By-Products Yielded by Grapes in California. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley and Martinez. Begun September, 1913.

No. 110. Improvement of Methods of Preparing Unfermented Grape Juice. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley and Martinez. Begun August, 1913.

No. 111. Standards of Composition of California Grapes and Wine. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley. Begun December, 1913.

No. 112. Improvements of the Methods of Vinegar Making in California. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley, Watsonville, Sebastopol, etc. Begun September, 1912.

No. 113. Methods of Germinating Olive Seeds. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley. Begun March, 1913.

No. 114. Preparation of Collection of Olive Trees at Davis, Kearney and Imperial and of Specimens at Berkeley. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley and Davis. Begun March, 1913.

No. 115. Improvement of Methods of Pickling Olives. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley. Begun December, 1913.

No. 116. A Study of Armillaria Mellea: with the Purpose of Finding Practicable Ways to put an End to Loss from this Fungus Among Trees and Shrubs. By W. T. Horne, reporting to Ralph E. Smith; at Berkeley, Fairoaks, San Jose, and other places. This is former Plant Pathology Project No. 8, commenced in previous years.

No. 117. Minor Investigations in Plant Pathology. By Elizabeth H. Smith, reporting to Ralph E. Smith; various places. Continuation of former work.

No. 118. A Study of Bacterial Disease of Olives known as Olive Knot, with the Purpose of Discovering the Method of Dissemination of the Causative Organism and the Conditions Governing Inspection, the Perfecting of a Practical Method of Control or Eradication and Study of the Pathological Changes Connected with the Knot Formation. By W. T. Horne, reporting to Ralph E. Smith; at Berkeley and Fair Oaks. Former Plant Pathology Project No. 10, commenced in previous years.

No. 119. Improvement of the Walnut Industry, Based Particularly Upon Control or Avoidance of Blight and Other Diseases. By Ralph E. Smith and S. S. Rogers, reporting to Ralph E. Smith; in various parts of the State. Continuation of previous investigations.

No. 120. Demonstration of Improved Methods of Enology: in Co-operation with the Extension Division. By W. V. Cruess, reporting to Frederic T. Bioletti.

No. 122. A Study of the Factors Influencing Seed Formation in Citrus Fruits. By J. Eliot Coit and Carl Nichols, reporting to J. Eliot Coit; at Commercial Orange and Lemon Orchards near Whittier and Riverside, Berkeley. Other places to be decided upon. Begun April 10, 1911.

No. 123. The Loquat. By Ira J. Condit, reporting to J. Eliot Coit. Begun February 1, 1914.

No. 124. Studies of the Feed Requirements and Milk Production of Milch Goats: (a) on the Value of Grain Feeds for Goats fed Alfalfa Hay. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True, University Farm, Davis, California. Suggested December 29, 1913.

No. 127. Insect Industries (b) Silkworms. Overcoming Dependence on Mulberry. By L. J. Nickels, reporting to C. W. Woodworth. Berkeley and Davis.

No. 131. Life Histories (a) Insects on Agricultural Crops. Cut Worms. By C. W. Woodworth, Berkeley.

No. 132. Life Histories (a) Insect Pests on Agricultural Crops. Minor Insects. By C. W. Woodworth, Berkeley.

No. 137. Life Histories (a) Insects on Agricultural Crops. Citrus Insects. By H. J. Quayle, reporting to C. W. Woodworth; Southern California.

No. 142. Life Histories (b) Forest Insects. Forest and Shade Tree Insects and Their Relation to the Diseases Affecting Such Trees. An effort to determine specifically for each of our native forest trees, the exact effect of each species of insects attacking them upon the physiology of the trees and just what insects may be responsible for death of trees. By Geo. A. Coleman, reporting to C. W. Woodworth; University of California campus; forest areas of Bay region; vicinity of Santa Barbara, and other localities in the State where the condition of the trees may require an investigation. Suggested January 1, 1914.

No. 151. Toxicity of Insecticides (a) Microscopical Identification of Components of Insect Powders. By C. W. Woodworth, Berkeley.

No. 158. The Pollination of Domestica and Triflora Plums Under California Conditions. By A. H. Hendrickson, reporting to B. B. Pratt. Location of the work at University Farm, Davis, California, and commercial orchards in representative sections of the State. Suggested January 22, 1914.

No. 159. Student Laboratory Plantings—a Study of Fruit Tree Stocks, Pruning and Planting Methods. By members of the teaching staff, reporting to B. B. Pratt; University Farm, Davis. Suggested February 4, 1914.

No. 160. Death of Animals and Cases of Serious Sickness at University Farm. By F. M. Hayes, reporting to H. E. Van Norman. Begun January 9, 1914.

No. 161. Weekly Report of Work in Progress at University Farm by Farm Division, Repairs and Power Division and Grounds. By T. Tavernetti, reporting to H. E. Van Norman. Suggested January 6, 1914.

No. 162. A Comparative Efficiency Test of Orchard Heating Devices. By W. W. Bonns and W. M. Mertz in co-operation with Dr. L. J. Briggs and J. W. McLane, U. S. D. A., reporting to H. J. Webber. Location of the work on or near grounds of the Citrus Experiment Station, Riverside, and such other locations as may prove desirable in the development of the work. Begun December 1, 1913.

No. 163. Reconnaissance Soil Survey of Sacramento Valley Areas, California. By J. W. Nelson and party, reporting to C. F. Shaw; Sacramento Valley, California, from Red Bluff south, below Suisun Bay (from 38° to 40° 15′ N) and from the foothills on the west of the hills on the east. Begun July 1, 1913; concluded February 14, 1914.

No. 164. Soil Survey of Southern California. By J. W. Nelson and party, reporting to C. F. Shaw; Southern California between the Pacific Ocean and the 116° 30′ W meridian and between the Mexican boundary and 30° 30′ N parallel of latitude. Begun February 1, 1914.

No. 166. Effect of the Use of Various Fertilizers on a Vineyard Growing in a Good Well-balanced Soil. (In co-operation with the Divisions of Soils and Fertilizers). By F. T. Bioletti.

No. 167. Irrigation Investigations, Duty of Water, Field Crops. Tank Work and Measuring Devices. By S. H. Beckett, reporting to Frank Adams; University Farm, Davis. Begun spring, 1910.

No. 168. Influence of Rotation upon Crop Producing Power of the Soil Without Treatment. By L. K. Marshall, reporting to J. W. Gilmore, Kearney Park, Fresno, California. Suggested 1909.

No. 171. The Study of the Efficiency of the Hinman Milking Machine. By F. W. Woll and Thos. E. Cooper, reporting to Gordon H. True. Location of the work at University Dairy Barn, University Farm, Davis, California. Suggested January 24, 1914.

No. 173. Fertilizer Experiment. By B. A. Madson, reporting to J. W. Gilmore; University Farm, Davis, California. Continuation of work of several years past. To be completed 1914 or 1915.

No. 174. Rotation Experiments. By B. A. Nelson, reporting to J. W. Gilmore; at University Farm, Davis, California. Begun November, 1913.

No. 175. Seed Exchange Experiment. By B. A. Madson, reporting to J. W. Gilmore; at University Farm, Davis, California. Continuation of work begun in 1907.

No. 176. Variety Trials with Wheat, Barley and Oats in Plots. By B. A. Madson, reporting to J. W. Gilmore; University Farm, Davis, California. Continuation of work carried on for a number of years.

No. 178. The Effects of Frost on Vines and Methods of Control. By Leon O. Bonnet, reporting to Frederic T. Bioletti; Berkeley. Suggested March 4, 1914.

No. 179. Comparative Cost of Hand Milking vs. Machine Milking in Commercial Dairies. By Edwin C. Voorhies, reporting to Gordon H. True. As many places in California as possible. Suggested March 1, 1914.

No. 183. Investigation of the Agricultural Value of the Major Fertilizing Constituents of Kelp: Nitrogen and Potash. By G. R. Stewart and others, reporting to John S. Burd. Begun January 1, 1914.

No. 184. Maintenance of Forage Supply in the Mountain Regions of California. By P. B. Kennedy, reporting to J. W. Gilmore. Six tracts not yet selected, in mountains of California. Suggested March 9, 1914.

No. 186. The Practicability of Growing Vegetables on the University Farm. By S. S. Rogers, reporting to H. E. Van Norman; University Farm, Davis. Begun January 1, 1914.

No. 187. Almond Culture. By R. H. Taylor, reporting to B. B. Pratt. Work carried on at the University Farm, Davis, California, and commercial orchards in representative districts. Suggested April 14, 1914.

No. 190. Cross-Breeding Peaches with Reference to (1) Improved Fruits, (2) Improved Rootstocks, (3) Study of Inheritance in Amygdalus. By E. B Babcock, R. E. Clausen, and others, reporting to E. B. Babcock. Begun February, 1909 (at Whittier); 1914 at Berkeley.

No. 191. A Study of the Fertilizer Requirements of Citrus Fruits. By H. J. Webber, W. M. Mertz, et al; at the Citrus Experiment Station, Riverside, California. Begun April, 1907.

No. 192. Green Manure Crops for Southern California: with Special Reference to Their use in Citrus Orchards. By W. M. Mertz, reporting to H. J. Webber; at Citrus Experiment Station, Riverside, California. Begun September 1, 1909.

No. 193. The Effect of Different Stocks on Commercial Species and Varieties of Citrus. By W. W. Bonns and W. M. Mertz, reporting to H. J. Webber. Series 1, Citrus Experiment Station, Riverside; Series 2, new site of Citrus Experiment Station and elsewhere as nature of work proves desirable. Begun April, 1907.

No. 194. A Study of the Varieties of Citrus Fruits and Their Relatives. By H. J. Webber, W. M. Mertz, H. B. Frost, et al, reporting to H. J. Webber. Citrus Experiment Station, Riverside, California. Begun February 1, 1913.

No. 195. A Comparative Efficiency Test of Orchard Heating Devices. By W. W. Bonns and W. M. Mertz in co-operation with Dr. L. J. Briggs and J. W. McLane, U. S. D. A., reporting to H. J. Webber. Work carried on on or near grounds of the Citrus Experiment Station, Riverside, and such other locations as may prove desirable in the development of the work. Begun December 1, 1913.

No. 197. Study of the Comparative Infectiousness of the Crown Gall Organism (Bacterium tumefaciens), with Special Reference to Finding Resistant Forms of Prunus Suitable as a Rootstock for the Various Stone Fruits. By C. O. Smith, reporting to H. J. Webber. Work carried on at Whittier, California. Begun March, 1910.

No. 198. Lemon Decay Fungi, with Special Reference to Their Control by Washwater Disinfection. By C. O. Smith and E. E. Thomas reporting to H. J. Webber. Work carried on at Whittier, California, as headquarters, with experiments and observation over all of Southern California. Begun April 8, 1911.

No. 199. Black Pit of Lemons. By Clayton O. Smith reporting to H. J. Webber. Work carried on at the Whittier Pathological Laboratory. Begun May, 1912; concluded July, 1913.

No. 250. Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and Other Fruit Trees. By H. S. Fawcett reporting to H. J. Webber. Work carried on at Whittier, Santa Paula, Chula Vista, Riverside, and other places. Begun February, 1912.

No. 251. Investigations as to the Cause and Treatment of Melakuma of English Walnut Trees. By H. S. Fawcett reporting to H. J. Webber. Work carried on at Whittier, Santa Barbara, and Ventura in co-operation with Mr. C. W. Beers, County Horticultural Commissioner of Santa Barbara County. Begun June, 1913.

No. 252. Routine Examination of Material Sent to the Citrus Experiment Station, and Minor Studies in Mycology and Bacteriology. By J. T. Barrett, C. O. Smith, and H. S. Fawcett reporting to H. J. Webber. Work carried on at Riverside and Whittier. Begun 1909.

No. 253. Some Studies of Mottling of Citrus Trees. By J. T. Barrett reporting to H. J. Webber. Work carried on at Riverside and various other locations. Begun April, 1914.

No. 257. A Study of the Horticultural Conditions in Florida, Cuba, and the Isle of Pines, with Special Reference to Citrus Culture. By H. S. Fawcett reporting to H. J. Webber. Work carried on at Florida, Cuba, and the Isle of Pines. Begun January 5, 1914; concluded March 1, 1914.

No. 258. The Nematode Problem on Citrus Trees. By E. E. Thomas reporting to H. J. Webber. Work carried on at Whittier, Riverside, and various points in Southern California. Begun December, 1912.

No. 259. A Study of Enzymes in Connection with Plant Diseases. By H. D. Young reporting to H. J. Webber. Work carried on at Whittier, California. Begun October, 1912.

No. 260. A Study of the Relative Influence of Different Factors on the Composition of Certain Fruits and Nuts. By H. D. Young reporting to H. J. Webber. Work carried on at Riverside and Whittier. Begun January, 1913.

No. 261. The Breeding and Improvement of Citrus Fruits. By H. J. Webber and H. B. Frost in co-operation with A. D. Shamel, U. S. Department of Agriculture, reporting to H. J. Webber. Work carried on at Riverside, Cal. Begun July, 1914.

No. 262. The Principles of Heredity in Certain Plants. By H. B. Frost reporting to H. J. Webber. Work carried on at the Citrus Experiment Station, Riverside. Begun October, 1913.

No. 263. The Origin, Nature, and Inheritance of Apparent Mutations in Certain Plants. By H. B. Frost reporting to H. J. Webber. Work carried on at the Citrus Experiment Station, Riverside. Begun October, 1913.

No. 264. The Comparative Value of Various Paints, Waxes, and Antiseptic Washes as Treatment for Wounds on Citrus Trees. By W. M. Mertz reporting to H. J. Webber. Work carried on at the Citrus Experiment Station, Riverside, in variety orchard. Begun April 26, 1913.

No. 266. A Study of the Freeze of January, 1913. By H. J. Webber, C. S. Milliken, A. R. Tylor, et al. reporting to H. J. Webber. Work carried on in Southern California with headquarters at Riverside. Begun January 20, 1913; concluded April, 1912.

No. 267. A Study of the Methods for the Determination of Sulphur Dioxide in Dried Fruits. By M. E. Jaffa.

Some indication of the scope of the investigations may be obtained by summarizing these investigations by divisions. The number of investigations, however, does not necessarily indicate the investigational activities of a division, since the work devoted to different projects necessarily varies greatly:

Division of Agronomy	14 projects
Division of Animal Husbandry	11 projects
Division of Citriculture	2 projects
Citrus Experiment Station	22 projects
Fertilizer Control Division	2 projects
Division of Genetics	3 projects
Irrigation Investigations	1 project
Division of Nutrition	2 projects
Division of Plant Pathology	5 projects
Division of Pomology	3 projects
Division of Poultry	1 project
Division of Soil Chemistry and Bacteriology	12 projects
Division of Soil Technology	4 projects
Division of Veterinary Science	17 projects
Division of Viticulture	20 projects
Division of Entomology	19 projects
University Farm	3 projects
	141 projects

RESEARCH AND POPULARITY NOT ASSOCIATED

The public has been very responsive to the Department's instructional work, made possible by the researches of my distinguished predecessors and their able associates. The man who has the ability to present to an audience in a clear and convincing manner the results of investigational work always obtains a satisfactory hearing. The man who understands the details of ordinary practice so as to relate the results of research to actual conditions is especially appreciated. Both types of men are very useful and very necessary to a successful Department of Agriculture. What all of us fail, however, sometimes to understand is that the men who actually extend the realm of knowledge and who, therefore, are in the last analysis the most useful servants of mankind perhaps rarely have any of these qualities. The men who made possible the building of the Panama Canal through their cloister-like researches on the life history of the yellow fever parasite may have been, from the standpoint of business, the most impracticable of men. The man who has done more than any other man in America to improve the dairy industry had this opportunity because the director of the station with which he was connected realized that research and popularity were not necessarily associated. The obvious difference in function between the men of research and the teacher or the men of direct public service creates a difficult administrative problem. The investigator who accomplishes most as an investigator must necessarily be much removed from the public mind. He may spend a lifetime on a problem of the greatest moment and finally leave its proper solution to others. The quicker rewards of other types of service often lure the ambitious man away from his task. Fortunately, however, as recently stated by Dr. Brooks, "no person attains to the highest joys who shirks difficulties." The Director of the station appreciates that if he fails to realize the fundamental requirements of men of research or fails to protect them in the quiet and orderly transaction of their tasks, he will fail in his full duty to the cause of agricultural progress in California.

PUBLICATIONS

The following is a list of the publications of the Agricultural Experiment Station. Those marked with a star are no longer available for distribution. The reports, bulletins, and circulars of the Agricultural Experiment Station are, in accordance with the law, distributed free of charge to any citizen of the state requesting the same. The mailing list, at the present time, numbers 22,000 addresses:

		Edition
Report of the College of Agriculture and the Agricultural Experiment Station of the University of California from July 1, 1912 to June 30, 1913		25,000
Bull. 240.	Commercial Fertilizers. J. S. Burd	20,000
Bull. 241.	Vine Pruning in California, Part I. F. T. Bioletti	30,000
Bull. 242.	Humus in California Soils. R. H. Loughridge	30,000
Bull. 243.	The Intradermal Test for Tuberculosis in Cattle and Hogs. C. M. Haring	30,000
Bull. 244.	Utilization of Waste Oranges. W. V. Cruess	15,000
	Total	150,000

Cir. 104.*	The Amended Insecticide Law. C. W. Woodworth	2,500†
Cir. 105.*	Analyses of Insecticides for Users. C. W. Woodworth	1,000†
Cir. 106.	Directions for Using Anti-Hog Cholera Serum. J. F. Mitchell	25,000
Cir. 107.	Spraying Walnut Trees for Blight and Aphis Control. R. E. Smith	8,000
Cir. 108.	Grape Juice. F. T. Bioletti	8,000
Cir. 109.	Community or Local Extension Work by the High School Agricultural Department. W. G. Hummel	15,000
	Carried forward	59,500

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† Not generally distributed.

	Brought forward	59,500
Cir. 110.	Green Manuring in California. C. B. Lipman	30,000
Cir. 111.	The Use of Lime and Gypsum on California Soils. C. B. Lipman	30,000
Cir. 112.	The County Farm Adviser. B. H. Crocheron	30,000
Cir. 113.	Announcement of Correspondence Courses in Agriculture. W. G. Hummel	40,000
Cir. 114.	Increasing the Duty of Water. B. A. Etcheverry	30,000
Cir. 115.	Grafting Vinifera Vineyards. F. T. Bioletti	15,000
Cir. 116.*	Silkworm Experiments. C. W. Woodworth	20,000
Cir. 117.	The Selection and Cost of a Small Pumping Plant. B. A. Etcheverry	30,000
	Total	284,500

The University of California Publications which bear on subjects relating to agriculture are issued in editions of 1000. The price charged for each is given below:

Volume I.

		Price
No. 1.	The Distribution and Activities of Bacteria in Soils of the Arid Region. Chas. B. Lipman	.30
No. 2.	Studies on the Phenoldisulphonic Acid Method for Determining Nitrates in Soils. Chas. B. Lipman and L. T. Sharp	.15
No. 3.	The Effects of Calcium and Magnesium Carbonates on some Biological Transformations of Nitrogen in Soils. W. P. Kelley	.10
No. 4.	The Aluminum Reduction Method as Applied to the Determination of Nitrates in "Alkali" Soils. P. S. Burgess	.15
No. 5.	Studies upon Influences Affecting the Protein Content of Wheat. G. W. Shaw	.75
No. 6.	The Effect of Copper, Zinc, Iron, and Lead Salts on Ammonification and Nitrification in Soils. C. B. Lipman and P. S. Burgess	.15
No. 7.	Studies on Ammonification in Soils by Pure Cultures. C. B. Lipman and P. S. Burgess	.25

Volume II.

No. 1.	Studies in Juglans I. Study of a New Form of *Juglans Californica* Watson. E. B. Babcock	.60
No. 2.	Studies in Juglans II. Further Observations on a New Variety of *Juglans californica* Watson and on Certain Supposed Walnut-Oak Hybrids. E. B. Babcock. (In press.)	

OCCUPATION OF GRADUATES

It is obvious that if instruction in Agriculture is to be worth while the graduates of the Agriculture College should have the opportunity of employing the training which they have received in a manner useful both to themselves and the state.

Statistics gathered from the agricultural students of the class of 1914 of this institution show that the total cost of the four years' course in agriculture was $1,792, and that of this amount each student earned by his own labor an average of $876, or 51 per cent of the whole. Only 22 per cent of these students owned farms or expected to inherit farms later. Like statistics were gathered from ten other universities. (See *Orange Judd Farmer*, May 30, 1914.)

The students in California earned the largest amount, although not the largest per cent of money, and had the least prospect so far as land or capital was concerned. In other words the students of this institution are more dependent upon securing employment for wages than those of any of the other ten institutions. Fortunately the opportunity for competent men to secure employment in agricultural pursuits in California is unexcelled.

Frequent demands for men trained technically reach this office. Graduates who have shown ability to assume responsibilities and handle men naturally are most in demand. Such men are quickly absorbed by the various activities of the state. However, in the past there has often been difficulty in finding suitable positions for graduates of less practical experience and promise. These latter men have not infrequently been drawn into non-agricultural positions where their horizon is not enlarged. The result has been that their earning power along the lines for which they were educated is not increased. Consequently as these men grow older they are lost to agriculture and the dearth of competent experienced and trained men continues.

In an effort to correct this condition, prominent men closely in touch with agricultural conditions in this state were informed of the men about to be graduated. Nearly all the men addressed responded with such promptness that the supply of available men was quickly exhausted.

There are more than a score of desirable positions open at present for properly trained men that it has not been possible to fill.

The inexperienced graduates have been so placed this year that it is believed they will develop into valuable men and thus will not be lost to the state.

BUILDINGS AND OTHER BETTERMENTS

Fertilizer Control Annex.—The need for offices, classrooms, and laboratory space at Berkeley remains unabated. To meet the existing serious demand of the sophomore class for the laboratory work in agricultural chemistry and soils there is being constructed an annex to the Fertilizer Control Building, at an estimated cost, including equipment, of $10,000.

It is a wooden two-story building 33 feet 6 inches by 76 feet 6 inches, containing three instructional laboratories, each with a capacity of thirty to a section, and two small research laboratories.

Insectary.—There has been constructed for investigations in entomology, an insectary in accordance with the plans prepared by Professor Woodworth, head of the Division of Entomology, at a cost approximately of $870. This building and the grounds appertaining to it constitute the most elaborate equipment of its kind.

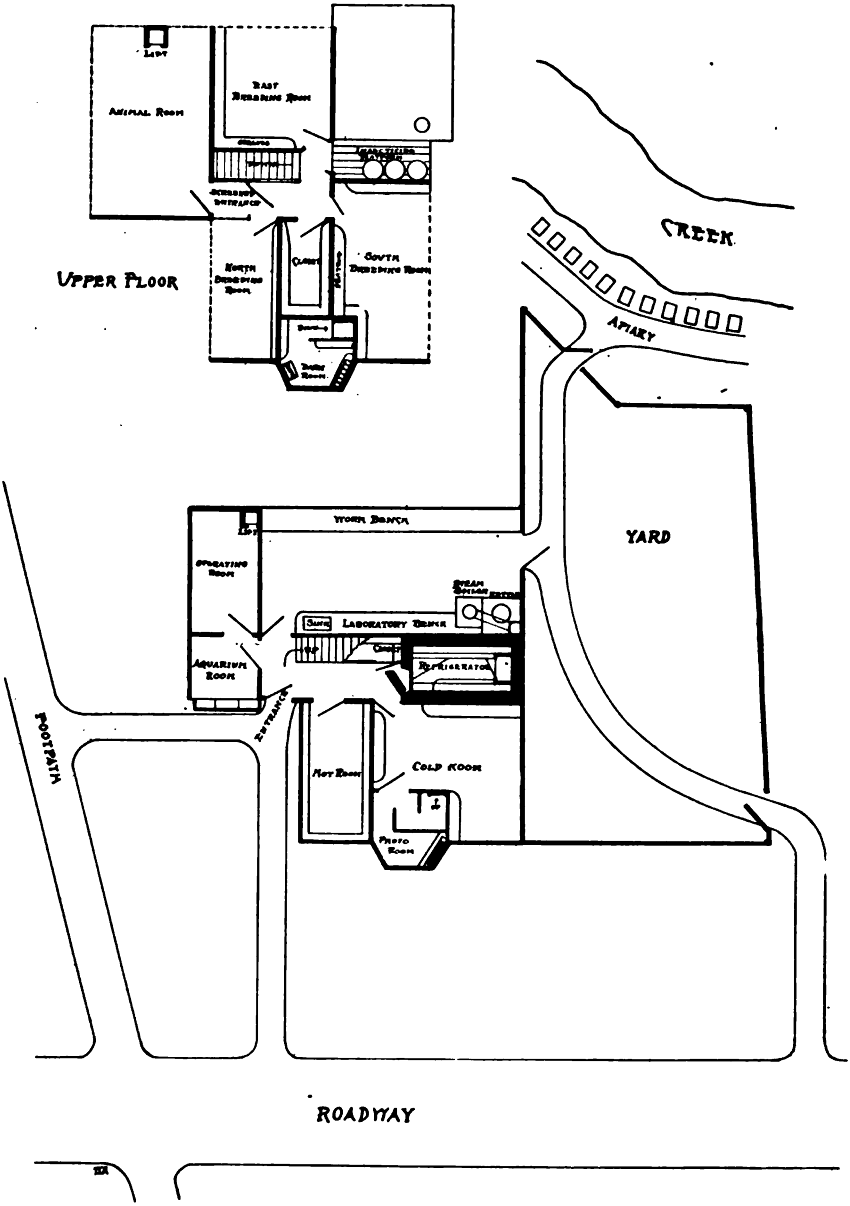
The Students' Apiary occupies a space about 50 feet long adjacent to the creek. The enclosure next to the building is now being used in a study of soil fumigants and has beds laid out around the edge for growing plants for the rearing of insects.

The largest laboratory room was used this spring as a workshop for the course in beekeeping and in the fall term will be used for that in insecticides. It is provided with a long workbench, with sink, a steam boiler and a large kettle mounted in masonry. The boiler furnishes steam for cooking insecticides along the bench and upstairs to a series of barrels on a platform, from which the preparation made may be delivered by gravity to the spray tank.

The equipment for the study of animal parasites consists of a large room enclosed in mosquito wire for keeping the animals. This has an entry way fully screened to prevent the access of flies. Connecting with the animal room above by an elevator is the operating room, one side of which is glass. Another side consists of closets for instruments and material.

Three wire enclosed rooms on the second floor are for the ordinary breeding work for plant pests. These have different exposures and therefore temperatures, and still greater variation is provided by two glass enclosed rooms on the first floor, one of which is to be kept at summer temperature by means of hot water pipes. Also on this floor a large refrigerator, taking a ton of ice, provides for studying the problems of hibernation.

An aquarium room provides the means of studying aquatic forms, including nine large aquaria, occupying an entire side of the room



There has been constructed for investigations in Entomology an insectary at a cost approximately of $870. This building and the ground appertaining to it constitute the most elaborate equipment of its kind.

and equally observable from the outside of the building. These aquaria are provided with a specially designed automatic aeration apparatus.

The photographing equipment consists of a set of five cameras supported vertically between posts independent of the building. They are arranged to five magnifications of ½, 1, 2, 4, and 8 times respectively; the distance from plate to photographic bench is ten feet, thus securing a great depth of focus. The upper ends of the camera are in the dark room on the second floor. The dark room attendant is apprised of the taking of a picture by a minute electric ruby light which is lit by the shifting of the focal plane shutters. He can then remove the exposed plate and load the camera for another picture, setting the shutter, and thus notifying the operator below that the camera is again ready to use. The photographic bench is provided with openings corresponding to the surface covered by the plate, so that the proper camera to use for each subject can be determined without delay and each camera is focused on the surface of the bench, reducing the focusing of the object to the act of bringing it at bench level. The bench is enclosed beneath and provided with louvers, trapping out all direct light, making a perfectly black field. Label holders provide for placing the number on the plate and also indicate the magnification. The object of the whole equipment is to provide cameras which can be adjusted once for all with greatest care and with every provision for producing the best photograph, and then to keep them unchanged and reduce the time of taking the photographic record to the minimum limit.

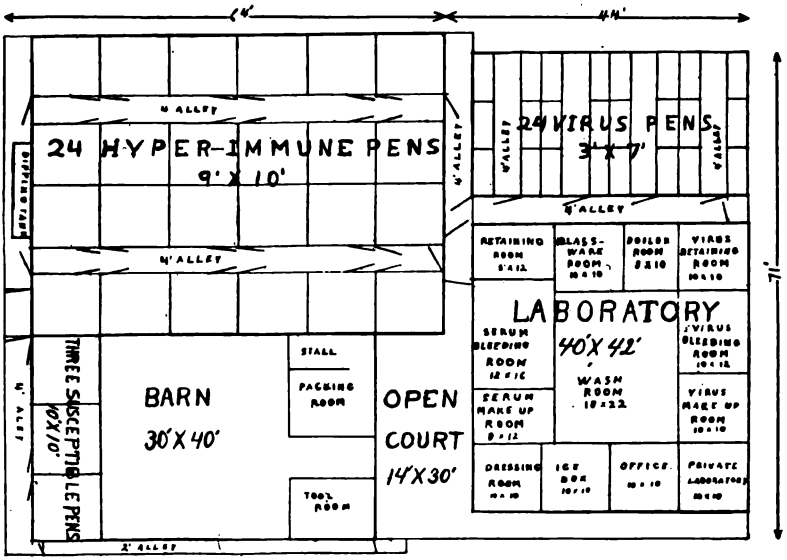
Greenhouses and Experimental Grounds.—Two new greenhouses 28 feet 8 inches by 50 feet, divided into four equal units and accommodating the divisions of Agronomy, Citriculture, Genetics, Plant Pathology, and Viticulture, have been erected just east of Agriculture Hall. Including the modification of an old building for head house, about $2600 has been expended.

These houses used in investigational work make available space in the old greenhouse for instruction in floriculture and plant propagation. The department, however, still continues to need new greenhouses of modern type and construction suitable for research and student work.

These new houses should be located in harmony with the agriculture group, and be made a permanent part of the University plan. There is also the continued necessity of maintaining the present amount of outdoor nursery and garden space, as well as grounds for the investigations of the several divisions, notably genetics and agronomy.

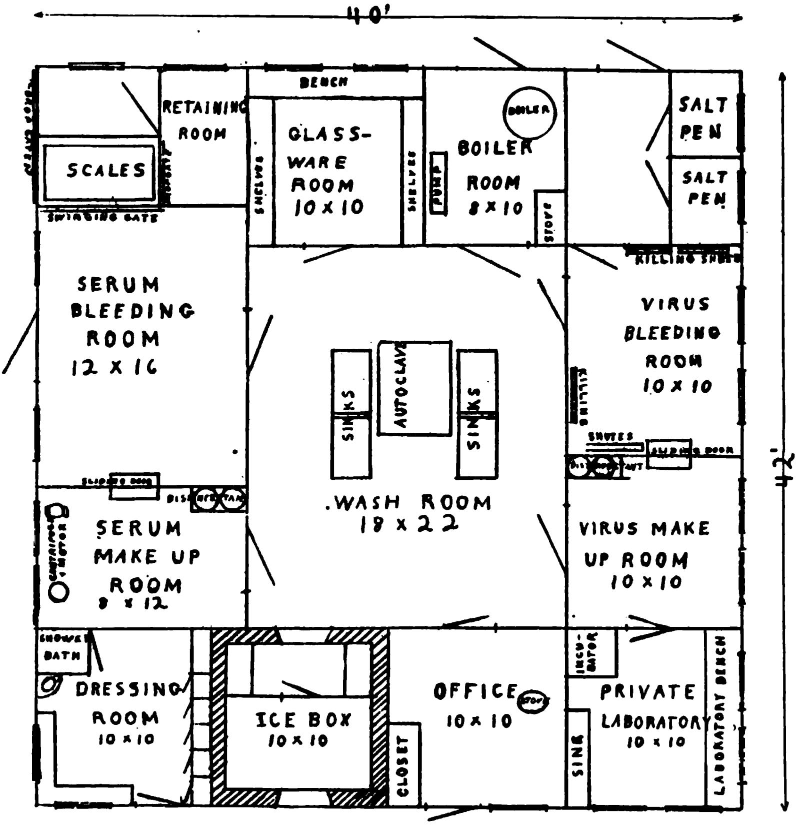
Hog Serum Plant.—In the latter part of the year 1913 a new site was secured for the Hog Serum Laboratory located at the foot of Sixty-sixth avenue in East Oakland, and a building costing approximately $5000 was erected on piles over the tide land. This location made possible the use of salt water for flushing and keeping the entire plant in a thoroughly sanitary condition. Since the plant is adjacent

The University of California Hog Serum Plant at the foot of Sixty-sixth Avenue, Oakland.



Ground plan of Hog Serum Laboratory, Pens and Barn.

to a railroad with spur track facilities, the cost of transporting the hogs and feed which are used at the laboratory has been reduced. An abattoir and rendering plant are near by. The virus hogs are sold to the rendering plant for fertilizer and the healthy hyperimmune hogs or those not susceptible to cholera are killed on commission at the abattoir and sold for pork at market prices.

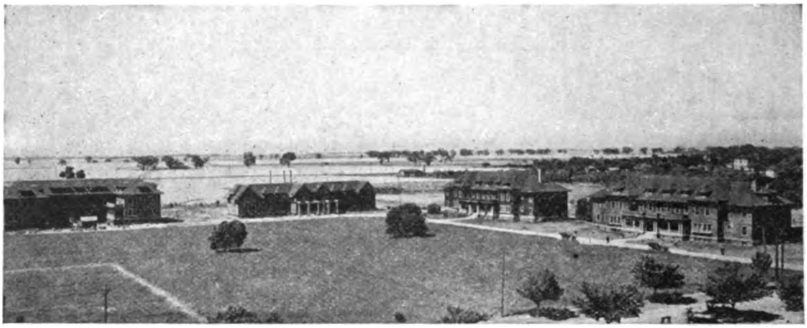


Enlargement of portion of ground plan showing interior equipment of Hog Serum Laboratory.

About $1,500 has been used in the purchase of additional equipment, which makes it possible to produce the very best grade of serum. The laboratory is provided with cold storage facilities for storing serum at a low temperature. On pages 42–43 are shown ground plans, giving the location of the pens for susceptible, virus and hyperimmune hogs.

The plant has a total capacity of about 3,000,000 cubic centimeters annually. The building is constructed of wood, with cement floors, the walls and inside roof being painted white, thus making it possible to keep the plant clean. The serum is produced in one set of rooms, while the virus is prepared in an entirely separate section of the plant.

Classroom Buildings.—The classroom building, for which the Legislature appropriated $65,000, is being constructed at the University Farm. It is a brick and cement building, two stories and a basement. It is 152 feet by 91 feet 11 inches. The building contains an auditorium with a seating capacity of 640, and a library 54 by 32 feet. There is a room for social activities, seven classrooms, and eight offices, together with the usual subsidiary rooms and accommodations.



Three dormitories and dining hall at the University Farm. The dormitory on the left and the left half of the dining hall has been built during the present fiscal year.

Dormitory No. 3.—The third dormitory, for which the Legislature appropriated $40,000, has been erected at the University Farm during the year.

It is built of wood in harmony with the previous dormitories, consisting of a basement and three stories. The basement contains two rooms suitable for class purposes. The first floor contains a large living room, while the rest of this floor and the two floors above are devoted exclusively to dormitory purposes. There are seventy-two sleeping rooms estimated to accommodate ninety-nine persons. The following table shows the living accommodations in the three dormitories:

	Sleeping rooms	Present capacity	Maximum capacity
Dormitory No. 1	51	79	87
Dormitory No. 2	56	85	95
Dormitory No. 3	72	99	109
	179	263	291

Dining Hall Addition.—An appropriation of $10,000 for a permanent addition to the Dining Hall gives the dining room 36 by 150 feet, and a seating capacity of 400 persons. The addition includes enlarged kitchen and storage space, baker's room and small dining room.

Office Building.—A one-story building 32 by 48 feet of shingle construction on a cement foundation, with the interior finish of redwood, has been completed at approximately $2600. It contains the office of the Dean of the University Farm School and Vice Director of the Agricultural Experiment Station and the business office of the University Farm.

Minor Buildings.—Through an appropriation of $20,000 for repairs and small structures it has been possible to build the office building just mentioned above, and to repair and repaint all the buildings on the University Farm, work that was very much needed.

A number of separate buildings have been erected. A beef cattle barn 38 by 120 feet was constructed at a cost of $3321. The ground floor contains twenty-three box stalls and a store room, while the second story is for the storage of hay and other feed.

A laying house for poultry, 25 by 50 feet, one and one-half stories high, each floor divided into two rooms, has been built at a cost of $478; while an existing building 16 by 50 feet for the storing of poultry food had a second story added at a cost of $338.

A Farm Mechanics building 48 by 70 feet, one story high, of shingle construction and cement floor, has been built largely by the class in Farm Mechanics, at an approximate cost of $1565. The building is connected with the blacksmith and carpenter shops by a roof 16 by 30 feet, providing suitable covering for the traction engines and other tools. A one and one-half story building 30 by 44 feet of similar construction has been erected for the storage of tools, lumber, plumbing and other supplies, at an estimated cost of $1000.

A small structure 16 by 20 feet has been erected for the special work of the Division of Entomology, while a garage 12 by 16 feet has been built, both for a nominal sum.

A well has been dug for the purpose of irrigating the area devoted to vegetable gardening, to facilitate the investigations of plant pathology, at a cost of $420. It is 12 inches in diameter, 125 feet deep, cased with No. 14 galvanized pipe double. A layer of gravel was found extending from 98 to 120 feet, below which is a bed of clay.

Dairy Building Repairs.—During the year improvements have been made in the Dairy Building. The stairway was changed and several partitions taken out, thereby increasing the floor space in the creamery, cheese and ice cream rooms by some seven hundred square feet. This additional space has aided materially in handling the large laboratory classes. Two new combined churns, a small power ice cream freezer, and three new cheese vats, besides other necessary equipment needed in the conducting of the commercial work, have been purchased during the year.

Feed lots at the University Farm showing cattle shed and silo erected during the year.

Betterments at the Imperial Valley Farm.—The deed to the last ten acres of the Imperial Valley Experiment Farm was secured by the payment of $1250 to I. W. Gleason by the Supervisors of Imperial County. This completed the purchase of the forty acres.

Several permanent improvements have been made on the farm in the last year which add greatly to the efficiency of the work done and add to the attractiveness of the place. A permanent concrete ditch 14 inches across the bottom and 15 inches across the top has been put across the front end of the farm. A concrete measuring weir with an automatic water register was installed to insure accurate measurements of water used in the various projects. A water-tight gate was put in to replace the old wooden gate. The construction of this ditch has not only made the water measurements more accurate, but has saved enough space to allow the planting of another row of trees across the forty, and will minimize the labor necessary in keeping the ditch clean of weeds and silt.

All of the ditches on the place have been reconstructed. Instead of the large "Fresno" made ditches, narrower ditches were made by hand and much space saved. The time saved in keeping weeds out will soon pay for the improvements.

All of the lands of the farm have been re-leveled and re-bordered and are now in good shape. The fence along the east line was continued across the north line, thus completing the fencing of the forty.

The large ditch bank running the entire length of the farm has been leveled down and a road constructed on top of it. This has saved the space necessary for a road and has made an otherwise objectionable bank a utility.

Much pains has been taken in keeping the place in a neat and attractive shape.

CO-OPERATION

Most of the co-operative agreements described in some detail in the last annual report have been continued. Irrigation investigations which were started in 1907 have continued as heretofore under the general supervision of Mr. Frank Adams, Irrigation Manager of the Office of Experiment Stations, with Mr. S. H. Beckett in immediate charge, as reported on page 124. Drainage investigations have been under way in co-operation with the same office with Mr. W. W. Weir in immediate charge. He is employed jointly by the co-operating institutions and reports to the Director through Professor Charles F. Shaw of the Division of Soil Technology.

The Bureau of Soils of the United States Department of Agriculture has co-operated with the California Agricultural Experiment Station both in reconnaissance and detailed soil survey work. A co-operative arrangement has been entered into whereby the United States Geological Survey has prepared topographic maps in advance of the soil survey of the Santa Rosa 15′ quadrangle, latitude 38° 15′ to 38° 30′, longitude 122° 30′ to 122° 45′. The Department of Agriculture of the University contributed one-half of the expense of the survey estimated not to exceed $5000.

The co-operative branch seed laboratory of the United States Department of Agriculture, established on October 5, 1912, with Miss Anna M. Lute in charge, reporting to Professor John W. Gilmore of the Division of Agronomy, has made the following determinations:

	1912-13 No. of samples	1913-14 No. of samples
Purity	540	855
Germination	825	1265
Identification	234	288

The Division of Agricultural Extension in co-operation with the Division of Farm Management, Bureau of Plant Industry, United States Department of Agriculture, through the State Leader, Professor B. H. Crocheron, has organized the farm adviser or county agent system with its farm bureaus, and assisted the students of the College of Agriculture in organizing boys' and girls' clubs in the high schools of the state.

The arrangement by which the expert work of the Alameda County and San Francisco Medical Milk Commission was conducted by the Division of Veterinary Science, with Dr. C. L. Roadhouse in charge has proven eminently satisfactory.

The department through the divisions of Soil Technology and Veterinary Science has co-operated with the Selby Smelter Wastes Commission in conducting studies on the effects of smelter wastes on soils and crops.

There are twenty acres of forest trees of many varieties over twenty years old at the Chico Forestry tract.

PERSONNEL

It is not possible within the limits of this report to refer to the personnel of the department or to give adequate expression to the work of the twenty-two divisions of instruction and investigation. The Division of Forestry has been created and instruction was begun in this subject in the second half-year, with Assistant Professor M. B. Pratt in charge. The head of the Division of Forestry, Walter Mulford, at present the head of the Department of Forestry of Cornell University, will take charge on August 1, 1914. The work of this division is being fostered by the kindly attitude of the lumber men of the state and by the enthusiasm of the students of the Forestry Club of the University. The subjects of study in forestry have already been announced.

The following list gives the Regents' appointments in the Department of Agriculture, who have begun their service within the fiscal year:

RICHARD LABAN ADAMS, Assistant Professor of Agronomy.

JAMES ALEXANDER ARMSTRONG, Field Assistant in Agricultural Extension, San Diego County.

JAMES T. BARRETT, Plant Pathologist in the Citrus Experiment Station and Professor of Plant Pathology in the Graduate School of Tropical Agriculture.

HARRY PERCY BARROWS, Instructor in Agricultural Education.

HAROLD E. BILLINGS, Laboratory Assistant in the Division of Agricultural Chemistry.

VIRGIL CLAY BRYANT, Assistant in Agricultural Extension.

ROY E. CAMPBELL, Assistant in Entomology.

DANIEL H. CAREY, Superintendent of Greenhouses and Gardens.

ANDREW HANSEN CHRISTIANSEN, Agricultural Adviser, Eureka, Humboldt County.

LILLIAN D. CLARK, Assistant in Agricultural Extension.

ROY ELWOOD CLAUSEN, Instructor in Genetics.

IRA J. CONDIT, Instructor in Citriculture.

B. H. CROCHERON, Assistant Professor of Agricultural Extension.

VALENTE FRANCIS DOLCINI, Assistant in Animal Husbandry.

H. H. DOUGLASS, Instructor in Dairy Husbandry.

HOWARD SAMUEL FAWCETT, Associate Professor of Plant Pathology in the Citrus Experiment Station and Graduate School of Tropical Agriculture.

HOWARD BRETT FROST, Assistant in the Citrus Experiment Station and Instructor in the Graduate School of Tropical Agriculture.

JOHN WASHINGTON GILMORE, Professor of Agronomy.

JOHN EDWARD GUERNSEY, Assistant in Soil Technology.

GEORGE H. HECKE, Farm Adviser, Yolo County.

ARTHUR HOWARD HENDRICKSON, Assistant in Pomology.

GEORGE W. HENDRY, Assistant in Agronomy.

D. R. HOAGLAND, Assistant Professor of Agricultural Chemistry.

O. W. ISRAELSEN, Assistant in Irrigation in co-operation with the Office of Experiment Stations.

TRACY R. KELLEY, Assistant in English and History in the University Farm School.

PATRICK BEVERIDGE KENNEDY, Assistant Professor of Agronomy.

OLLY J. KERN, Assistant Professor of Agricultural Education.

WYLIE EVERETT LLOYD, Assistant in Poultry Husbandry.

FRANK FARRINGTON LYONS, Assistant in Agricultural Extension, San Joaquin County.

WILLIAM C. MATTHEWS, Instructor in Scientific Illustration.

LAWRENCE KNOX MARSHALL, Assistant in Agronomy.

CARL SPENCER MILLIKEN, Assistant Superintendent of Agricultural Extension.

DAVID N. MORGAN, Assistant to the Director.

WALTER MULFORD, Professor of Forestry.

J. W. NELSON, Assistant Professor of Soil Technology.
LESLIE J. NICKELS, Instructor in Insect Industries, Davis.
W. F. OGLESBY, Assistant in Viticulture.
FRANK L. PETERSON, Assistant Professor of Farm Mechanics.
BURR B. PRATT, Assistant Professor of Pomology.
MERRITT BERRY PRATT, Assistant Professor of Forestry.
NILES POND SEARLS, Assistant in Agricultural Extension, Yolo County.
LESLIE T. SHARP, Assistant Professor of Soil Chemistry and Bacteriology.
ALFRED SMITH, Instructor in Soil Technology.
RALPH T. STEVENS, Assistant Professor of Landscape Gardening.
GUY R. STEWART, Assistant Professor of Agricultural Chemistry.
THOMAS TAVERNETTI, Assistant to the Dean of the University Farm School.
WALTER JENNINGS TAYLOR, Assistant Professor of Veterinary Science.
GORDON H. TRUE, Professor of Animal Husbandry.
E. C. VOORHIES, Assistant in Animal Husbandry.
WALTER WALLACE WEIR, Drainage Expert in the Division of Soil Technology.
FRITZ W. A. WOLL, Professor of Animal Nutrition.
CLEO JACK ZINN, Assistant in Soil Technology.

It is proper to state that a few of the individuals named have served the University in some other connection prior to their appointment by the Regents.

The following changes in title have been made for the ensuing year:

W. T. HORNE, from Assistant Professor to Associate Professor of Plant Pathology.

Miss E. H. SMITH, from Plant Pathologist to Instructor in Plant Pathology.

S. S. ROGERS, from Instructor in Plant Pathology to Assistant Professor of Plant Pathology.

P. S. BURGESS, from Instructor in Soil Bacteriology to Assistant Professor of Soil Chemistry and Soil Bacteriology.

H. J. QUAYLE, from Assistant Professor to Associate Professor of Entomology.

C. L. ROADHOUSE, from Assistant Professor of Veterinary Science to Associate Professor of Veterinary Science.

J. F. MITCHELL, from Instructor to Assistant Professor of Veterinary Science.

W. M. MERTZ, from Assistant in Pomology to Superintendent of Cultivations.

E. J. LEA, from Assistant Professor to Associate Professor of Nutrition.

S. H. BECKETT, from Instructor in Irrigation to Assistant Professor of Irrigation Practice.

In a department so complex and withal so new, with twenty-two divisions and fifty odd new appointees, there are necessarily many points of contact. Between divisions there is often a shadow land which is not yet well defined and may never become so. It is a source of gratification therefore that in the enthusiasm for their work these several divisions and individuals find it possible to exercise that elasticity which makes possible an effective whole. If there is one thing more than another by which the staff is characterized, it is a willingness to serve unstintingly the public for which the department was created.

The Director has summarized the reports of the several branches and divisions of the Department of Agriculture in the following pages.

Very respectfully submitted,

THOMAS F. HUNT.

At the University Farm. The Office Building on the right was built during the present fiscal year.

REPORTS OF DIVISIONS

THE UNIVERSITY FARM

BY

H. E. VAN NORMAN

University Farm School.—No striking change has been made in the course of study as outlined at the beginning of the present school year, except that systematic work in Vegetable Gardening has been added under the supervision of Mr. S. S. Rogers, and Entomology under Mr. L. J. Nickels, and the work in the shops, forge and farm machinery has been grouped together as a division of ''Farm Mechanics'' on a par with the division of Animal Husbandry, Dairy Industry, etc.

The raising of the entrance age in the fall of 1912 and the emphasis put upon the courses as designed for older men who have not high school graduation as a preparation for further education, brought an increased number of this class of men, as will be seen from the figures following. An unexpected influx of high school graduates offering credits equivalent to our first year's work threw an unforseen teaching burden into the second-year subjects, rather than the first year, as anticipated.

Attendance.—The total number of new students entering at the beginning of the first semester was 122, of whom fourteen had no high school training; fifty-nine were graduates of high schools, and forty-nine had one or more years of high school work. Nine students entered with credits from other institutions of college grade.

The short courses brought 134, and during the second semester, sixty-one University students were enrolled, of which number three were young ladies.

Twenty-two new students enrolled in the three-year course at the opening of the second semester, of whom thirteen were high school graduates, eight had one or more years of high school work, and one had less than one year. Seven students entered with credits from other institutions of college grade.

The student enrolment for the year included four students from the Philippine Islands, two from Chile, one from India, one from Germany, one from Australia, one from China, one from Mexico, and from the states, New Jersey, 1; Illinois, 1; Utah, 1; Nevada, 2; the balance from our own state.

The following students were given a certificate on May 22, 1914, upon successfully completing the three years' course in Agriculture at the University Farm School:

Dolph Chadwick Allen
Lucius Ray Bates
Ralph Edgar Beam
John Jeremiah Bogardus
Clifford Edgar Bresee
Hugh Dyer Cameron
Theodore John Cameron
Leo Rowland Canman
Harold Gustavus Claudius
Irl Daniel Dickson
Chun Johnston Hargitt
William Dean Haupt
Karl Herman Hummel
Marion Raymond Laird
Stephen George Langford
Bernard Alexander Lucke
Winfred Harold Moebus
John Spafford Rowell
Alvin Charles Schammel
Allan Hartwell Showler
Bruce Marcus Stern
George Dorian Walton
George Charles Watson
Walter Dresser Whitman
George Richard Wilson
Carol Willard Wright

SUMMARY OF ENROLMENT FOR THE YEAR

		Total
Farm School students:		
1st semester, new	122	
1st semester, re-entered	66	
2nd semester, new	22	
		210
Short Course students:		
General Agriculture	47	
Animal Husbandry and Veterinary Science	27	
Dairy Farming	16	
Dairy Manufactures	22	
Horticulture and Viticulture	45	
Poultry Husbandry	11	
Visitors, all classes	2	
	170	
Deduct for registration in more than one course	36	
		134
University students, second semester		61
Total enrolment		405

During the year six students have been dropped for inefficient work, and thirty-seven have dropped out without completing the semester's work begun, due to various causes of a personal nature.

INSTRUCTION

In addition to the instruction mentioned elsewhere, the following has been given:

Botany.—Mr. C. J. Wight of the Botany Division has had a student assistant during the second semester, Mr. H. K. Dickson, who desired to secure necessary practice for teacher's certificate. He has conducted one laboratory section and delivered six lectures in Plant Breeding, to each of two sections of the class. Eighty-five students have been registered during the fall semester, and seventy-five for the spring semester. A collection of 160 specimens of native plants of Nevada County was made during the summer vacation, also several native forage and poisonous plants, and seeds of bur clover have been collected.

Chemistry.—The peculiar variety of preparation possessed by students makes this a difficult course to teach. A beginning has been made, however, and a suitable laboratory guide and manual for this class of students is being worked up. Sixty-six students were registered during the fall semester, and eighty-six the second semester.

English.—Sixty-two students were registered during the fall semester, and forty-two during the spring semester. Mr. Kelley has also acted as Secretary of the Faculty, and Chairman of the "Committee on Scholarship."

Hygiene.—Emphasis has been placed on personal hygiene, sanitation and first aid to the injured, to all first-year students, who numbered 144 for the year.

Irrigation.—Instruction has been given to thirty-six Farm School students, and twenty-four University students, in addition to the investigational work reported elsewhere.

Mathematics.—Instruction has been given to eighty students in mathematics, and forty in surveying.

Soils.—Instruction has been given to ninety-seven students the first semester compared with forty-three the preceding year. In addition to this work, Mr. Koeber has taught a class in Farm Mechanics.

Vegetable Gardening.—Instruction in this subject has been given to nineteen regular and two special students the second semester. A beginning has been made in the accumulation of the necessary equipment and tools for instructional work.

Special Lectures.—Wednesday of each week at eleven o'clock has been set aside for a general assembly. Some days the hour has been devoted to matters of interest to the Associated Student Body. These meetings have been addressed by the following prominent men:

S. P. Frisselle, Manager Kearney Ranch	Fresno
G. H. Hecke, County Horticultural Commissioner (Yolo)	Woodland
W. G. Stimmel, Manager Vina Ranch	Vina
Miss Stella Huntington, County Librarian (Yolo)	Woodland
Albert M. Paul, with Natomas Consolidated of California	Sacramento
A. J. Cooke, Horticultural Commissioner	Sacramento
Geo. P. Weldon, Deputy Horticultural Commissioner	Sacramento
Thos. R. Murphy, Fire Chief of San Francisco	San Francisco
Harris Weinstock, California Industrial Commissioner	San Francisco

Sunday evening at 6:10 there has been held a sunset meeting in the living room of the dormitory during the winter, and on the lawn when the weather permitted. Messrs. Albert Rinn (a University student and member of the University Glee Club) taking work at the University Farm during the second semester, and Walter Whitman, of the senior class at the Farm School, have had charge of the music, which has added much to the interest in these meetings. The following speakers have addressed the meetings:

Prof. T. H. Reed, Political Science Department, University of California	Berkeley
Prof. J. W. Gilmore, Agronomy Division, University of California	Berkeley
Judge C. E. McLaughlin	Sacramento
Prof. H. E. Cory, English Department, University of California	Berkeley
Charles G. Titus, Secretary Y. M. C. A.	Sacramento
J. E. Stubbs, President, University of Nevada	Reno, Nevada
A. C. Jenvy, Graduate Princeton University (visitor)	Davis
Edward Hyatt, State Superintendent Public Instruction	Sacramento
Mr. Edward Berwick, Universal Peace Propagander	Monterey
Max Thelen, Railroad Commissioner	San Francisco
Benj. Ide Wheeler, President University of California	Berkeley
Clare M. Torrey, Secretary to President University of California	Berkeley
Mrs. W. Longbotham, Chairman Music Committee, State Federation Women's Clubs (Northern District)	Sacramento
Forrest Plant, Soloist	Davis

Student Activities.—Discipline in the dormitories has been wholly in the hands of the Student Association, and instructors who formerly received perquisites in the way of room rent for the supervision of student discipline have been relieved of that responsibility and pay their regular room rent. The Student Conference Committee, conferring with the Dean on matters of importance, was appointed earlier in the year. This has been succeeded by a Welfare Committee, as an integral part of the Associated Students' organization.

During the second semester an Agricultural Club was organized, numbering some sixty members, and including both University and Farm School students in its membership. A splendid harmony has prevailed this second semester between the University students and Farm School students resident on the campus; a marked improvement over that of a year ago.

University Farm Administration.—With the beginning of the fiscal year, the re-organization incident to the abolition of the Superintendent of the Farm, Principal of the School, and Business Manager, and the grouping of these responsibilities under the direction of the Vice-Director and Dean, with an assistant, and the administration of school matters through committees reporting to the Faculty, became fully effective.

Several divisions have been represented by resident members of the staff of the College of Agriculture, resulting in increased activities in those lines of work. The development of a vegetable garden, which should supply certain fresh vegetables to the Dining Hall and others who may desire them, with the resulting opportunity for actual practice in vegetable growing by the students, and the acquiring of first hand information for the answering of correspondence, is a feature of the year's development.

Farm.—Practically all the crops produced on the farm have been fed on the farm. In addition to the regular routine work of the Farm Division, a large amount of hauling of gravel for drives and of lumber for the construction-work has been done by its teams and laborers.

In addition to the products of the Farm consumed on the Farm, the sales from July 1, 1913, to June 30, 1914, have been as follows:

Poultry	$2,665.29
Agronomy	611.97
Animal Husbandry	17,337.12
Viticulture	273.18
Dairy	55,191.48*
Total	$76,079.04

Grounds.—The supervision of the grounds has been placed in the hands of Mr. F. Flossfeder of the Viticulture Division, who has had much experience in the growing and handling of ornamental plants.

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* See page 108.

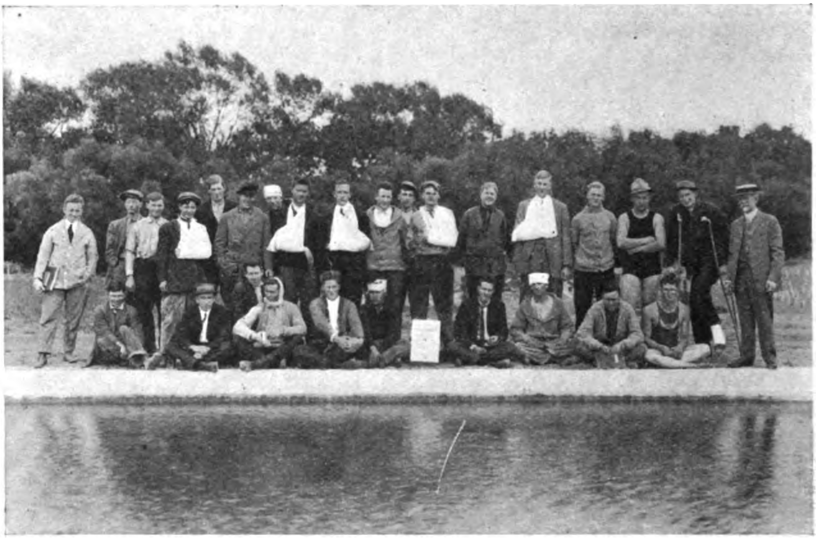
The unusual amount of rainfall, making for favorable planting of ornamental material, has prompted the setting out of a large number of ornamental trees and shrubs. The selection of varieties has been made by Professor J. W. Gregg of the Division of Landscape Gardening at Berkeley, according to a systematic plan. The maintenance of this material will involve a constant expense for water and cultivation until the trees get large, when little will be required.

Class in hygiene being given a first-aid lesson in resuscitation at the University Farm, Davis.

Infirmary.—A total of 173 cases have been handled in the Farm School Infirmary, which were: Abscesses 4, boils 18, sprains 12, felon 1, tuberculosis 1, carbolic poison 1, influenza 7, coryza 18, headaches 16, acne 7, ringworms 5, varicocele operation 1, catarrh (nasal) 3, tonsilitis (acute) 7, infected wounds 20, punctured wounds 15, fractures lower leg 2, plaster casts 3, fractured toes 2, fractured fingers 3, finger amputation 1, ingrowing toe nails 2, warts and corns 6, periostitis bone of foot 1, acute bronchitis 8, antityphoid vaccination 2, acute pharyngitis 2, chilblains 2, pneumonia 3.

In addition to the usual run of minor ills, the infirmary was called on to care for one case of pneumonia involving the employment of an extra night nurse.

For the first time, every student was required to submit to a physical examination at the opening of the school year. Fortunately, it was not necessary to reject any as physically unfit. Examination of the eyes and ears showed an unusual freedom from serious defect. Examination of the eyes by Dr. Milton H. Schutz showed 99 of 159 students suffering from errors of refraction. About two-thirds of these have been properly corrected; the remainder were advised to give their eyes the necessary attention to correct this condition. Seventy-eight had more or less nasal defects, some of which are undoubtedly affecting their ability to study.



First aid to the injured is a part of the curriculum.

Library.—The library has received 163 new books by purchase, and 65 by gifts, 27 of which were donated by a student, Mr. C. A. Halsey. The total number of books in the library is 2,169, of which 560 are herd books, shelved at the Animal Husbandry Division. Some 950 bulletins have been received during the year. Eighty-seven periodicals are received regularly, 38 of which are gifts.

The library is a distributing station for the Yolo County Free Library. About 100 books of fiction have been handled through this co-operative arrangement between the County and State library. Any books in the State Library have been available upon request through this arrangement.

Gifts.—The University Farm has received the following gifts during the past year in addition to those enumerated in the reports of Animal Husbandry, Dairy Industry, Farm Mechanics and Poultry Husbandry, and in addition to numerous loans.

CASH CONTRIBUTIONS

Ministers (attending "Ministers' Week," December, 1913)	$339.75	
Marin County Teachers' Institute, account lecture by H. E. Van Norman at their meeting April 7-14	25.00	
British Columbia Live Stock Association, Honorarium account lecture by H. E. Van Norman	10.00	
		$374.75

EQUIPMENT

Curley redwood for making office table.
By Promotion & Development Committee, Humboldt Chamber of Commerce, Eureka, Calif.

1 Redwood stave silo.
By the Redwood Manufacturers Company, San Francisco.

Sample grains South American corn, 1 inch long by ¾ inch wide.
By D. O. Lively, Department Live Stock, Panama Pacific Exposition, San Francisco.

CITRUS EXPERIMENT STATION

BY

H. J. WEBBER

In the Citrus Experiment Station the year has in large measure been one of reorganization. The new plans for the enlargement of the Station necessitated the employment of new men, purchase of equipment and development of plans for the extension of the investigations. This work of reorganization is still in progress and cannot be completed until the new Experiment Station farm and buildings are ready for occupation. It has been necessary to maintain the work started at the old Citrus Experiment Station at Riverside, which has served as temporary headquarters for the Station and at the Pathological Laboratory in Whittier, a part of the force being maintained in each place. The maintenance of the force in separate places and the impossibility of developing the laboratories and library in permanent place has been a great interruption to the proper development of the work. Fortunately this condition will soon be remedied as rapid progress is now being made in the preparation of the new site. Material progress has been made, nevertheless, in the organization of the staff of workers, and in the investigations, so that the year has been a valuable and active one.

A Study of the Fertilizer Requirement of Citrus Fruits.—This experiment, first outlined by Prof. Ralph E. Smith, was started on new land, the young trees being selected and planted particularly for the purpose. Twenty different plats were included, each of which was given a different treatment. Each plat contains 24 trees, 6 naval oranges, 6 valencia oranges, 6 Eureka lemons and 6 Lisbon lemons. Each plat is separated on every side from every other plat by guard rows of trees not included in the experiment, other than to prevent the influence of one plat extending over to another. The irrigation of each plat is separate, no water from one plat crossing onto another.

The trees were planted in April 1907 and are thus seven years old. They began bearing in 1910 and there has thus been four crops, but the freezes of 1913 and the preceding winter caused considerable damage, particularly to the lemons. The Lisbon lemon is a late bearer and this character, coupled with frost injury, has prevented a crop production on these trees of a size sufficient to give any results of interest.

The following table gives the treatment of each plat and the average yield per tree for four years in number of fruits per tree:

AVERAGE YIELD PER TREE FOR FOUR YEARS IN NUMBER OF FRUITS

	Plat A	*Plat B*	*Plat C*	*Plat D*	*Plat E*
	Complete Fertilizer	Nothing	Blood	Sulfate of Potash	Bone
Navel	84	27.66	96.5	29.33	152
Valencia	53.16	3.16	169	12.5	155.25
Eureka	161.83	115	184	78.16	139

	Plat F	*Plat G*	*Plat H*	*Plat I*	*Plat J*
	Manure	Nitrate Soda, Blood, Bone	Nitrate Soda	Muriate of Potash	Superphosphate
Navel	54.66	61.83	169.83	24.2	43.5
Valencia	68.83	64.83	111	33.33	76
Eureka	65.33	80.33	126.16	130.33	107

	Plat K	*Plat L*	*Plat M*	*Plat N*	*Plat O*
	Bone and Potash	Nitrate Soda, Blood, Potash	Nothing	Acid Phosphate	Manure and Slag
Navel	54.5	68.16	92	86.5	69.25
Valencia	59.66	73.6	46	50.66	72
Eureka	119.33	169.5	75	93	172

	Plat P	*Plat Q*	*Plat R*	*Plat S*	*Plat T*
	Superphosphate and Bone	Complete	Sulfate of Potash	Blood	Nothing
Navel	61	103.33	59.66	193.66	119.33
Valencia	95.83	137.83	93.83	110.83	71.33
Eureka	88.66	164.16	59.33	93.16	43.75

A few important suggestions can now be deduced from the results, but the experiment must run for a much longer period before the final results will be visible. The trees are still young and the early yields are naturally low.

The most noticeable factor is the high yields of the nitrogen plats, in particular plats C and S, treated with dried blood, and plat H, treated with nitrate of soda. The low yield of the untreated plats labeled "Nothing" is also worthy of note, considering the indifferent effects sometimes obtained in the use of fertilizers. Plate A and Q, treated with what is ordinarily designated as a complete fertilizer,—that is, one containing what is supposed to be the nearly correct amount of potash, phosphoric acid and nitrogen—are in excellent condition and gave good comparative yields. The manure plats are rather disappointing in yield, but the trees are in excellent condition. In general the potash plats are poor in yield and the trees show little growth, being slightly if any better than the untreated plats.

One of the most interesting features of this experiment is the different degree or amount of mottle leaf shown by the different plats. Mottle leaf, which is probably a symptom of many diseases, is apparently the first sign of weakness or disease in the tree.

The nitrate of soda plat (H), which has given a very high yield up to the present time, is now very badly mottled, about eighty per cent of the leaves being discolored. This plat is clearly the worst mottled plat in the grove. It seems to be true that every plat receiving any nitrate of soda is badly mottled, as for instance, Plat A, 50 per cent, G, 50 per cent, H, 80 per cent, L, 60 per cent. Plat Q, however, which had nitrate of soda in a complete manure along with blood, superphosphate and sulfate of potash, was graded as having only 5 per cent mottling. Nitrogen from organic sources does not seem to have the same effect, as the blood and manure plats show much less mottling.

The best plats in the experiments, all points considered, seem to be those treated with dried blood, as they have not only given high yields but appear very healthy.

The present results from the experiments would therefore indicate the importance of nitrogen fertilization, and the desirability of using nitrogen from organic sources rather than from such chemicals as nitrate of soda. They would also suggest that the soil at the Experiment Station requires a minimum amount of potash. The results would leave us in doubt regarding the importance of phosphoric acid but suggest a medium amount as desirable.

It must be clearly recognized that the results as yet give only suggestions. These experiments must be carried for a much longer period before the final results can be given. It is of the highest importance to get conclusions from a much larger and more complete series of plats and this, it is expected, will form one of the main lines of investigation in the future.

Green Manure Crops for Southern California with Special Reference to Their Use in Citrus Orchards.—An experiment to determine the value of the nitrogen added through the medium of leguminous green manure crops was inaugurated by Mr. J. H. Norton, during the fall of 1909. Since the latter's resignation, the work has been conducted by Mr. W. M. Mertz.

This experiment consists
plats alternating with each
during the winter months, w

In the early spring the
Following this, all of the c
crops sown.

As soon as these crops ha
plats are treated with varyi
cultural operations are carri
of the field crops are accura
of each plat. The results th
value of the utilized nitroge
soda and legumes.

The following table gives
in green tops per acre:

- *Purple vetch (Vici
- †Tangier peas ....
- Melilotus clover (M
- Fenugreek ....
- Common vetch (Vi
- Lentils ....
- Bur clover ....
- Barley and rye (av
- †Bitter vetch (Vicia
- Canadian field peas

* Grown for one year only.
† Seed not yet available com

From this table it is se
field peas, which are most g
material per acre than sev
purple vetch and melilotus c
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The melilotus clover has
four year test. It is found
of California and is appar
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lowing its incorporation wit

The following table gives the yields of corn, potatoes and sugar beets following the incorporation of the different green manures with the soil.

Soil Treatment	4-year average yield shelled corn in bushels per acre	2-year average yield potatoes in bushels per acre	2-year average yield sugar beets in tons per acre
Common vetch	35	171	15.3
Barley plus 810 lbs. nitrate of soda	34	191	16.0
Bur clover	35	228	17.3
Barley	29	152	13.4
Barley plus 270 lbs. nitrate of soda	32	166	12.5
Vetch, V. ervila	38	231	16.7
Barley	27	166	10.7
Canadian field peas	40	243	17.6
Barley plus 1080 lbs. nitrate of soda	41	218	17.7
Tangier peas	42	227	20.5
Barley	28	163	12.3
Melilotus clover	46	252	19.8
Barley plus 540 lbs. nitrate of soda	42	204	15.7
Fenugreek	43	255	16.8
Barley	35	164	12.7
Lentils	43	204	19.5
Average yield on legume plats	40	226	17.9
Average yield on barley plats	30	161	12.3
Average increase due to nitrogen added by legumes	10	65	5.6

From this table it is seen that very marked increases in yield have resulted from the additions of nitrogen to the soil. It is of interest to note the large quantities of nitrate of soda necessary to bring up the yields on the barley plats on a par with those growing legumes.

This is especially significant because of the fact that practically the same amount of organic material was plowed under in the case of the non-legume plats as on those growing legumes.

Thus the great differences in the yields is apparently due to the nitrogen added from the air through the symbiotic action of the nitrogen fixing bacteria with the roots of the legumes.

The Effect of Different Stocks on the Commercial Species and Varieties of Citrus.—A study of the varying effects of different stocks upon citrus trees was started at the Riverside Station in April, 1907, according to plans prepared by Professor R. E. Smith and assistants. The varieties consist of Washington navel and Valencia oranges and Eureka lemon, grown upon sweet, sour and trifoliate orange stock and upon pomelo. The experiment originally comprised 222 trees, divided into two blocks on different locations on the station grounds. Block A comprised 55 trees, and block B, 167 trees.

In May, 1909, the Washington navels on pomelo in Block A were removed from their original position, and set as a continuation of the row of navels on sour stock. Such transplanting excluded these trees from the experiment.

Of the original number of trees in the experiment, a few have in the course of the work been killed by cold or disease. Treatment in respect to fertilization, cultivation, irrigation, and cover cropping has been uniform.

To date the trees in respect to size and vigor rank in descending order as follows:

Washington Navel Orange

Block A	Block B
1st. Sweet.	1st. Sweet.
2d. Trifoliate.	2d. Sour.
(Removal of sour stock trees previously noted.)	3d. Trifoliate.

Valencia Orange

Block A	Block B
1st. Pomelo.	1st. Trifoliate.
2d. Sweet.	2d. Sweet.
3d. Sour.	3d. Pomelo.
4th. Trifoliate.	4th. Sour.

Eureka Lemon

Block A	Block B
1st. Sweet.	1st. Sour } about equal.
2d. Sour } practically	2d. Sweet }
3d. Pomelo } equal.	3d. Pomelo.
4th. Trifoliate—markedly dwarfed.	4th. Trifoliate—markedly dwarfed.

The differences in the growth in the two blocks may be partially ascribed to soil differences.

Block A is on a somewhat lighter soil than B, which doubtless accounts for the improved showing of trees on trifoliate stock in the latter block. On the heavier soil trees on trifoliate roots hold their own in comparison with other stocks in the case of oranges. The striking fact brought out is the marked dwarfing of the lemon trees on trifoliate in every instance. Another noticeable fact is the increased diameter of the trifoliate stock below the bud union in practically all cases.

The following table is a summary of the crop data for the years 1910–1913 inclusive. The data for lemons is for 1910–1912 inclusive, no fruit resulting after the freeze of January, 1913.

RESULTS, 1910–13

			Average Yield in number of fruits per tree				
Variety	Stock	Number of trees in plot	1910	1911	1912	1913	Average Yield per tree, 1910–1913
Washington	Sweet	45*	.04	4.3	22.6	120	143.9
Navel	Sour	16*	0	6.2	40.7	162.6	172.6
Orange	Trifoliata	19	0	7.4	43.2	66.4	117.0
	Sweet	20	0	4.6	41.4	139.9	186.0
Valencia	Sour	16	0	5.6	44.8	130.3	180.7
Orange	Trifoliata	20	1.1	23.8	119.3	206.2	350.5
	Pomelo	17	0	3	36.6	143.1	182.8
	Sweet	15	1.1	2.1	110.7	No	113.9
Eureka	Sour	18	.8	5.8	126.5	fruit	133.2
Lemon	Trifoliata	20	6.8	17.3	73.4	in	97.5
	Pomelo	10.6*	4.2	16.1	159.3	1913	171.7

* Indicates average number of trees in plot where some have died in the course of the experiment.

In point of fruit production, the first year shows little or no yield, with a natural increase in each successive season. By 1913 the navel on sour has outstripped the crop on sweet in respect to yield, with trifoliata a poor third. Valencia orange on trifoliate shows a consistent and striking advance both in yield per tree and average yield for four years over the other three stocks.

In the case of Eureka lemon, pomelo holds first place with sour, sweet and trifoliata following in the order named.

A Study of the Varieties of Citrus Fruits and Their Relatives.—The commercial orchards of California are in large measure limited to plantings of Washington Navels and Valencia Oranges, Eureka and Lisbon Lemons, Marsh Seedless Grape Fruit and the Dancy Tangerine. These are doubtless the best varieties now available, but it is questionable if they represent the highest perfection obtainable. California produces more citrus fruits than any other region in the world and it is important that all known varieties should be introduced and tested in the state in comparison with the varieties now grown.

For several years different varieties have been accumulating at the station. Trees of 14 different varieties besides the ordinary sorts were planted in 1907. Trees of 53 other different sorts have been budded previous to January 1, 1914. During January and February of 1914 Prof. H. S. Fawcett of the station visited Florida, Cuba, and

1911—1913
143.5
172.6
117.5

186.1
180.7
350.5
182.5

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United States Department of Ag
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A Comparative Efficiency Tes
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A Study of the Comparative R
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Resistant Forms of Prunus Suit
Stone Fruits.—Studies, by Mr. C
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both of the above investigations
being determined by growing seed
by artificial inoculations with pu
ism, *Bacterium tumefaciens.* Exp

ful where used on small trees not too severely infected. Special use of germicides on roots of nursery trees before planting in orchard is being tested. It is hoped that some practical control may be secured from this latter treatment.

A Study of Lemon Decay Fungi, with Special Reference to Their Control by Wash Water Disinfection.—This particular disease causes serious decay in lemon packing houses, and special attention is being given to finding more effective methods in the use of germicides to be used with the wash water in its control. The spores during the winter months are produced in the orchard and brought into the packing house in the fruit. The decay develops in three or four weeks during the curing or storage of the fruit.

The experiments now under way are very promising, but not sufficiently complete to be reported upon at this time.

The same fungus is becoming of importance in the orchards, as under certain favorable climatic conditions it is capable of infecting the fruiting and other twigs. Occasionally small citrus trees wrapped with corn stalks have been attacked as well as orange seed bed stock.

A Study of Black Pit of Lemons.—This blemish, which has been studied by Mr. C. O. Smith, is probably the first bacterial disease of citrus fruits to be described. It appears to a limited extent in the lemon orchards of Southern California during the winter and spring months, and is caused by a new species of bacterium, *Bacterium citriputeale*. This organism has been studied and its life history worked out. The disease has been artificially produced on lemons, Navel and Valencia oranges, grape-fruit and limes.

The spots or pits are found entirely in the rind, are circular or oval in outline ¼ to ½ inch in diameter, firm (not a soft rot), reddish brown to black in color. The diseased tissue is depressed somewhat below the normal oil glands into the white substance of the rind. In the center of the pits can often be found an injury, like a thorn stab, where the infection has taken place. The disease at present is well distributed throughout the lemon growing sections of California, but is not sufficiently abundant to demand special control measures.

Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and Other Fruit Trees.—A further investigation has been made by Prof. H. S. Fawcett of the causes and best methods of control of gum diseases of citrus trees. The disease known as Gummosis is characterized by dying of large areas of bark on the trunk accompanied by the exudation of gum. The importance of these diseases is indicated by a statement from a prominent lemon grower to the effect that he had taken out one per cent per year of large bearing trees from gummosis alone. This not take into consideration the injury to trees that were weake by the disease, but not sufficiently injured to be taken out. B series of inoculation experiments extending over more than two ye it has been conclusively shown that the causal agent in at least forms of Gummosis are fungi, the brown rot fungus (*Pythiacy citrophthora*), and the grey fungus (*Botrytis vulgaris*), both known as causing rots of fruit in the citrus packing houses.

As the result of a large number of experiments in the prevent and cure of Gummosis carried out in co-operation with a numbe citrus growers, it has been shown that in addition to the previou well known methods of prevention these forms of Gummosis may successfully prevented by painting the trunks with a concentra Bordeaux wash known as Bordeaux paste, and trees already affec may be cured if taken in time by cutting out diseased bark and pa ing the wounds and entire trunk with Bordeaux paste.

Certain other fungi were also shown to be capable of induc gumming in citrus trees. Wounds of all kinds made on the heal bark of citrus trees were found to heal without gumming, unless taminated with organisms or subjected to chemical stimuli.

A large part of this work was done by Prof. H. S. Fawcett w employed by the State Commission of Horticulture, from Febru 1, 1912, to September 1, 1913. The work has been continued and investigations extended since that time. The Brown Rot Gumm has also been definitely shown to be present in Florida, Cuba and Isle of Pines.

Investigations as to the Cause and Treatment of Melazuma of E lish Walnut Trees.—Investigations as to the cause and treatment new disease of English walnuts in Santa Barbara County, which been called Melaxuma, were begun by Prof. Fawcett in June, 1 at the request of Mr. C. W. Beers, County Horticultural Com sioner. The disease is characterized by large, black cankers on larger limbs and trunk and by the girdling and wilting of sma branches. Mr. W. H. Nixon and Mr. C. A. Hollister had previo proved that the disease was infectious by transmitting it from eased cankers to healthy limbs by means of ax or chisel cuts and the insertion into healthy bark of pieces of diseased material. Furt inoculation experiments with material from diseased cankers firmed this work. Cultures of a fungus were obtained from th cankers, which on being inoculated into healthy limbs were show be capable of producing the disease. A few preliminary experim in treatment indicate that the cankers may be checked in their spr by cutting out and treating with a fungicide as Bordeaux or lime sulfur paste.

Routine Examination of Material Sent to the Citrus Experiment Station, and Minor Studies in Mycology and Bacteriology.—Outside the special field of citrus and walnut diseases there frequently arise troubles more or less seriously affecting other agricultural crops. These will receive consideration as they arise. While no project, aside from one on Crown Gall, has been outlined for any one special disease of this class, provision is made to include such studies under a general project covering observations and studies on minor troubles. If, at any time, some one or more of these so-called minor maladies becomes of sufficient economic importance, the same may be given special attention and a new project formulated.

Some Studies on Mottling of Citrus Trees.—In taking up the careful study of such a general disease as mottling, it must be recognized that there are open to the investigator several points of attack. Different single or grouped factors may be concerned in different localities. Therefore there appears to be no best line of attack which stands out prominently above all others. It is therefore not easy and possibly not desirable to formulate all studies pertaining to mottle leaf under one project.

Aside from the study on the relation of the citrus nematode to mottle leaf and the various fertilizer, soil, and stock experiments which have a bearing on the same, a project has been planned with a view to obtaining more information concerning the effects of the disease on the host, and the relation of certain factors to its occurrence.

It is proposed to determine the relation of starch formation and translocation to mottle leaf; to compare the histology of diseased with that of normal leaves; to make a comparative study of the roots of the diseased and healthy trees; to determine the relation of iron to mottling; and to ascertain whether mottle leaf is an infectious type of chlorosis.

A Study of Fruit Spots and Stains.—Fruit blemishes, particularly certain well defined spots and stains, have been so prevalent during this season that they have demanded special attention. These troubles have caused in some localities considerable loss on account of dropping, decay and lowering of grades of fruit.

Studies thus far carried on by Dr. Barrett have not revealed the cause of either the brown or green spots, two of the most prevalent spot troubles. Their general characteristics indicate that they are not due to parasitic organisms. A third trouble, which presents the appearance of a dull reddish green stain on oranges, lemons and pomelos, has been usually prevalent in certain localities. This disease is now believed to be caused by a fungus of the Gleosporium type. Experiments to definitely determine this point are now under way.

A Study of the Horticultural Condition in Florida, Cuba and Isle of Pines, with Special Reference to Citrus Culture.—In a trip to Florida and Cuba during the winter, in addition to the importation of bud wood of citrus varieties, Professor Fawcett made a study of citrus conditions with special reference to diseases. It was definitely shown for the first time by isolating pure cultures of *Pythiacystis citrophthora* from diseased gumming trees that the Brown Rot form of Gummosis was present in the above countries. The same fungus was also found associated with a case of so-called footrot or Mal-di-gomma in Florida. Important data in regard to the similarity or difference of other diseases to those occurring in California were gathered. Interesting data were also obtained in regard to the methods of treatment of citrus groves on various soils to obtain good results in these countries. One of the most striking observations was the beneficial effects of covering the entire soil with a deep straw mulch on certain soils in Cuba. While it may be impossible to apply these methods without modification to California conditions, they serve as valuable suggestions for future experimentation. A series of photographs illustrating different phases of citrus culture in these countries was also made.

The Nematode Problem on Citrus Trees.—A preliminary report by Mr. E. E. Thomas of a nematode found attacking roots of citrus trees was issued in February, 1913 (Circular No. 85). Since that time extended observations have been made in various parts of the state to determine the extent of spread of the pest. It has been found in practically every section of the state where citrus trees are grown. Many groves and nurseries, however, still apparently remain free from infection.

Careful studies are now being made to determine the effect of the nematodes on the trees. In one experiment 20 trees, each of five different varieties, Eureka and Lisbon lemons, Washington Navel and Valencia oranges and Marsh Seedless pomelo, all budded on sour stock, were planted in large pots in steam sterilized soil. Half of these pots were later inoculated with nematodes in order to compare infected and non-infected trees.

To test the relative effect on the three most generally used stock. 200 seedlings each of sour orange, sweet orange and grape fruit are being grown in small pots of steam sterilized soil. In each case 100 seedlings have been inoculated with the nematode. To further test the relative susceptibility of different stocks, 20 plants each of 12 other varieties were planted in sterilized soil and then inoculated with the nematode.

The roots affected with nematodes almost always show also a growth of fungus mycelium, probably a species of Fusarium. The relation of this fungus to the nematode and to the damage of the trees is also being studied in the field and in a special series of pot cultures.

The relation of the nematode to Mottle Leaf has not yet been demonstrated, but the experiments under way should within the next year give fairly conclusive evidence on this point.

A Study of the Relative Influence of Different Factors on the Composition of Certain Fruits and Nuts.—During the year analyses have been made by Mr. H. D. Young of Navel oranges from the different plots in the fertilizer experiments at the Riverside Station. These plots furnish an excellent opportunity to discover whether or not it is possible to affect the quality of the fruit by changing the fertilizer applied, since in the twenty plots nearly every combination of the usual fertilizers is found. From this, the first year's work, it seems that the effect on the recognizable qualities, such as sweetness and acidity, is very slight. However, although the fruits from the individual trees showed great variation, the average of the plots receiving potash alone showed the fruit to be a little sweeter than that from the other plots. Of the plots receiving only one of the usual elements of fertility, the phosphoric acid plots ranked second in sweetness, the nitrogen plots, third. One of the most striking things shown was that the juice of the fruit from the plots receiving nitrogen in any form, uniformly showed a higher per cent of nitrogen.

The possible relation of the rootstock on the fruit has also been under investigation chemically. Navel oranges grown on sweet stock were found to have more sugar and less acid than those grown on sour stock. Fruit from trifoliata stock had less of both sugar and acid than either of the others. It also produced a slightly firmer fruit. The continuation of this investigation for several years should give conclusions of considerable value.

A Study of the Freeze of January, 1913.—A study and observation on the effect of the freeze of the winter of 1913 has been continued during the year. While the principal portion of the work was concluded by the fall of 1913, the publication of the studies has been delayed to await the full recovery of the groves under observation. With the fine growth thrown out by the trees all over the state this spring, the recovery may be said to be complete and the results of the study will now be tabulated and published as early as possible.

A picnic is held annually at the University Farm.

AGRICULTURAL CHEMISTRY

BY

JOHN S. BURD

Fertilizer Control.—The Fertilizer Control work, consisting of the inspection of fertilizers found on the market throughout the state, together with samples received from consumers, has continued as usual, and about six hundred samples of such materials have been analyzed in the laboratory. Experience has shown that examinations of approximately this number are sufficient to maintain on a high basis the standards under which fertilizers are being sold.

Examination of Water.—During the year the service rendered in the matter of examination of water supplies has been entirely reorganized and the attempt has been made to make it more useful. Owing to technical questions in connection with the interpretation of the results of water analyses and to the lack of information on the part of the public with regard to same, it is difficult to render the maximum service without undue waste of time on the part of members of the staff. On this account it is undesirable in many cases to make complete analyses as frequently requested by our correspondents. It has, therefore, been determined to inaugurate the system of making partial analyses which shall be as comprehensive as is justified by the character of the sample submitted, reserving the complete analyses for those waters whose properties would otherwise be in doubt. The total number of complete analyses which will have been made approximates one hundred and seventy-five, in addition to about fifty samples upon which a partial analysis has been made. In connection with these water analyses it has been possible frequently to condemn waters which were unsuitable for specific purposes and to give warnings and advice with regard to the utilization of other supplies.

Research.—Three projects have been inaugurated during the year to which all of the members of the staff have devoted considerable of their time, Professor Stewart's time being exclusively devoted to this work. These projects are:

Investigation of the Moisture Content and Fertilizing Value of the Principal Kelps Found on the Coast of California.

Investigation of the Nature and Commercial Value of the Proximate Principles and Distillation Derivatives Present in the Principal Constituents of Kelp—Nitrogen and Potash.

Investigation of the Agricultural Value of the Major Fertilizing Varieties of California Kelp.

These projects comprise the various phases of a comprehensive study of the agricultural and commercial utilization of kelp and have indicated the possibilities and limitations of this material in the above connections.

AGRICULTURAL EDUCATION

BY

W. G. HUMMEL

The instructional work of the division has included the giving of courses in agricultural teaching methods at the University during the summer session of 1913 and during both semesters of the 1913–1914 college year. It has also included the conduct of correspondence courses in agriculture prepared by members of the faculty of the College of Agriculture.

Correspondence Courses in Agriculture.—In September, 1913, the first four correspondence courses in agriculture were ready for students. Eleven are now completed. Twenty-one other courses have been announced as in preparation.

The courses now ready for students are as follows:

Alfalfa culture (Course no. 1)	ready Sept. 18, 1913
Grape growing (Course no. 23)	ready Sept. 18, 1913
Citrus fruits (Course no. 24)	ready Sept. 18, 1913
Walnut culture (Course no. 21)	ready Sept. 26, 1913
Poultry husbandry (Course no. 14)	ready Oct. 20, 1913
Fig culture (Course no. 26)	ready Nov. 20, 1913
Onion culture (Course no. 5)	ready Dec. 16, 1913
Swine husbandry (Course no. 11)	ready Mar. 10, 1914
Barley culture (Course no. 8	ready Mar. 17, 1914
Olive growing (Course no. 25)	ready Mar. 30, 1914
Home floriculture (Course no. 27)	ready Mar. 30, 1914

The first correspondence course lesson was sent out September 18, 1913. From that time up to April 30, 1914, 31,605 lessons have been sent out.

The present (April 30, 1914) enrolment in agricultural correspondence courses ready for students is 6743. Of this number 5986 are taking their first course; 599 are re-enrolments. Two hundred and forty-seven students are taking their second course; 28 a third course; 4 a fourth course; and 1 a fifth course. One hundred and fifty-eight students have completed one course, but have not enrolled in another as yet. Since some students have taken several courses, the actual number of different correspondence course students reached so far is 6424. Thirteen hundred and sixty-six students are enrolled in courses not ready. A total of 7790 different students are enrolled in courses ready and in preparation. A total of 8109 registrations have been received for the various courses.

Many students apply for registration in more than one course at a time; but they are permitted to enroll in one course only until that one has been completed.

The character of students reached by the correspondence courses is indicated by the following statistics as to their occupations. Out of a total of 6424 students enrolled up to April 30, 1914, in courses ready for study, 2390 are farmers; 550 are housewives; 113 are engineers; 924 are tradesmen and mechanics; 128 are merchants; 249 are professional men; 242 are teachers; 816 are clerks, stenographers and bookkeepers; 150 are brokers, real estate and insurance men; 233 are students; 629 occupation unknown. That is, 37 per cent are actually engaged in farming; 9 per cent are housewives, many of whom are farmers' wives; 2 per cent are engineers; 14 per cent are tradesmen and mechanics; 2 per cent are merchants; 4 per cent are professional men; 4 per cent are teachers; 11 per cent are clerks, stenographers and bookkeepers; 3 per cent are brokers, real estate and insurance men; 4 per cent are students; and 10 per cent, occupation unknown. Many of those classed among professional men own farms now rented.

The opinion of students as to the value of the correspondence course work to them is indicated by their letters to be of a most satisfactory character.

The average age of students is estimated to be 33. This estimate has been arrived at by averaging the ages of the first hundred correspondence course students in each thousand enrolled.

Enlisting the interest of large numbers of ambitious students scattered throughout the state at this age of high capabilities, and giving them practical, scientific information as to the best methods of conducting different agricultural enterprises, should give no small impetus to agricultural progress in the state.

Correspondence course students are enrolled from every county in California except Alpine. They are also enrolled from thirty-four States, Alaska and Hawaii. There are students in Japan, Greece, Mexico, Canada, Cuba, the West Indies, and the Fiji Islands.

Talks and Lectures.—Among the extension activities of this Division, the work of Assistant Professor Kern deserves special mention. He has given very nearly half of his entire time to talks and lectures on education for country life. These talks total, up-to-date, 82. Of these 60 were to general audiences, 18 to teachers' associations, and 4 to farmers' institutes.

Professor Kern's work has been of great value in arousing interest in and enthusiasm for better country schools and a richer country community life in this state. It is desirable to continue these talks on education for country life until at least a few people in every country community in California have a vision of that community's possibilities. There must also be begun definite, constructive work for country schools and the communities which they serve.

Definite, practical suggestions for rural school and rural community improvement will be offered by this division whenever requested.

Investigational Work.—An investigation with regard to the use of land in connection with agricultural teaching in high schools, started during 1912–1913, was continued during the present year and much additional information was secured, especially as to the use of home land by high school agricultural pupils as a part of their school work. Valuable material was also collected with regard to the use of land by Normal and other secondary schools teaching agriculture.

The right use of land in connection with high school agricultural teaching is undoubtedly one of the most important and difficult problems with which agricultural teachers have to deal. It is frequently the least successful phase of the agricultural work in high schools. Yet, if agricultural instruction in high schools is to accomplish what is claimed for it, it must be accompanied by successful, educational use of land, either at home or at school.

Agriculture in California Schools.—According to reports so far received, sixty-one high schools are now teaching agriculture, an increase of ten over 1912–1913. The courses vary from one to four years in length.

Reports from thirty-four county superintendents state that agriculture or agricultural nature-study is being taught in some of their elementary and grammar schools. Three county superintendents have reported that no instruction which could be termed agricultural is given in their schools.

School garden work is reported in thirty-three counties.

AGRICULTURAL EXTENSION

BY

W. T. CLARKE

Farmers' Institutes.—The work of this division has covered a number of activities. During the year 205 Farmers' Institutes have been held in 41 out of 58 counties of the state. The total attendance at these Farmers' Institutes was 37,356, or an average attendance of 182 per institute. At these institutes the subjects of present actual importance in the communities where they were held were discussed by experts from the College of Agriculture and Experiment Station.

Movable Schools.—Two Movable Schools or Extension Schools have been held in communities where dairy and animal industry problems were of very considerable importance. These schools were held at Modesto and Turlock and the instruction given at them was intensive and well calculated to assist the interested farmers in better handling their dairy herds. The total attendance at these two schools was 2200; the average attendance per day was 183.

Agricultural Clubs (Adults).—Feeling that the extension work would be more permanent and a more satisfactory result obtained if the farmers, both men and women, in various neighborhoods could be well organized, there has been established 13 agricultural clubs in seven counties of the state, with a total membership of 460. These clubs are very active and during the ten months in question have held a total of 155 meetings. At these meetings occasionally representatives of the College of Agriculture have appeared and have addressed the members and invited guests on agricultural topics that were considered important in the regions where the meetings were held. These clubs have also carried on a considerable amount of work without the College of Agriculture's representatives being present. This work has consisted of the presentation of papers on different subjects and the discussion of these papers. Many of the papers in question have come into this office and indicate a very careful and well studied interest in the subjects discussed.

High School Agricultural Clubs.—The agriculture of the state for the future depends absolutely upon the development of intelligent workers. These workers must come from our schools and colleges. Through the enthusiastic action of the agricultural club of this college acting in co-operation with the Extension Division, agricultural clubs have been established in 84 high schools of the state. These are distributed through 30 counties and have an average membership of 15, making a total of 1260. This work is being pushed energetically and there will undoubtedly be very considerable additions to this number of clubs in the ensuing twelve months.

Fort Bragg Potato Club boys in their plats. May 26, 1914.

Fairs.—The College of Agriculture of the University of California has been represented at nine fairs in California in the past ten months. At these fairs exhibits have been presented, showing forth the investigational and educational work being done by the college and station. A total attendance has been noted of 88,151 of these individuals. The station and college was also represented at the National Corn Exposition at Dallas, Texas. At this exposition, held in February of the current year, 37 of the experiment stations and colleges of agriculture of the United States were represented, as was also the United States Department of Agriculture. A careful estimate of the number of visitors actually passing through the exhibit of this institution and asking questions of the demonstrators in charge thereof gives a total of 20,000 visitors there.

Personal Visitation.—While the great majority of questions raised by our correspondents and visitors have been answered by letter without further data than that given in these letters or conversations, in certain cases it has been necessary for members of the extension staff to make personal visits to various properties situated in different parts of the state, and examine these properties for the benefit of the persons interested therein. This particular work is of considerable value, inasmuch as the advice offered is of such a nature as to assure the individual interested in the land of its value or its lack of value, and to post him as to methods of handling either the land or the crop growing upon the land. Eighty such examinations have been made in the ten months under consideration.

To recapitulate, the department has been in direct touch with various individuals in the state and without the borders of the state as follows:

Through Farmers' Institutes	37,356
Through movable schools	2,200
Through agricultural clubs	460
Through high school agricultural clubs	1,260
Through fairs	108,151
Through letters	25,301
Through land examinations	80
Through Ministers' Week	501

giving a total of 175,309 individuals actually in touch with this institution through our Extension Division during the past ten months.

County Farm Advisers.—Quoting from circular No. 112, January, 1914:

"It has been said that the agricultural institutions of the country are like a great manufactory grinding out a product of infinite value which has been stored in warehouses far from the consumer that the product was designed to reach. Lacking a retail force of agents, this product continued to accumulate without greatly affecting the consumer and his wants. Like the manufactory, the agricultural institution must have its agents close to the point of consumption so that the product may be readily placed in the hands of those who need it. These agricultural agents are now being established throughout the nation under the name of 'County Farm Advisers.' They act as the necessary force to bring the information of the agricultural colleges, experiment stations, and the national department of agriculture to the specific farmer who needs it.

The farm adviser is an agent both of the College of Agriculture of the University of California and of the Office of Farm Management, United States Department of Agriculture. He is placed in a county where his services are desired. His entire time and activity are spent there within the boundaries of that county. There he is the field agent of the agricultural forces of the nation.

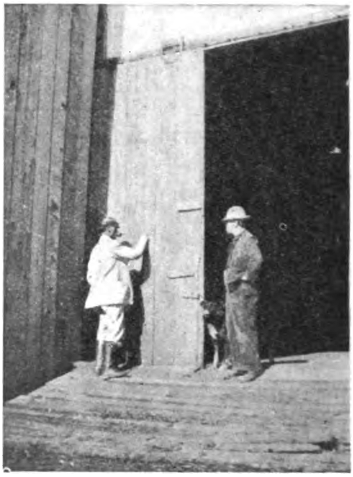
The farm adviser has an office or headquarters at some central point in the county, usually at the county seat. He may also, through the organization of a farm bureau, find it desirable to have other local or district headquarters at scattered places throughout the county.

The farm adviser is interested in good results wherever he finds them. He may carry the methods of the best farmers from ranch to ranch. On the left barley grown by ordinary methods; on the right by summer fallowing and early planting.
(Mr. M. T. Popplewell, Supt. Jamul ranch.)

Day by day the farm adviser goes where he is called, advising on the various questions that come to him. When, as is sometimes the case, he meets a problem that to him is impossible of solution because of the technical phases involved, he submits it for consideration to the agricultural college or to the federal department of agriculture, the forces of both of which he has at his command.

Specifically, the work of the farm adviser may be divided into four general branches, as follows:

(1) Investigation or research into the larger problems of farm management as applied to that specific community.



A farm adviser writing the formula for lime-sulphur wash on the barn door. A note-book is sometimes lost, not so the barn door.

(2) Demonstration or application of these principles and practices through the co-operation of interested farmers.

(3) Advisory work with inquirers, that is, the answering of questions and giving of advice to those who apply.

(4) Organization work of the civilizing forces of the community—assistance to boys' agricultural clubs, farmers' organizations, schools, churches and marketing, and buying organizations.

The work of the farm adviser is supervised by a state leader, appointed jointly by the College of Agriculture and the United States Department of Agriculture, to which he makes weekly reports.

The farm adviser's salary is paid by the College of Agriculture of the University of California. His expenses are paid by local agencies within the county.

About two thousand dollars a year is estimated to be necessary in most cases for the expenses of the farm adviser. These mean the maintenance of an office and office facilities, the use of a small automobile for travel within the county, and the subsistence of the farm adviser while away from home.

In order to facilitate the work of the farm adviser and to conserve his time as much as possible, it is desirable that some permanent organization be in advisement with him regarding problems of the county. Such an organization is a farm bureau as organized in many parts of the United States. The farm bureau is the organization of farmers around certain local district headquarters where the farm adviser is due at definite intervals and times for consultation with the members of the bureau and for demonstration on their farms of the methods under discussion for their county."

AGRONOMY

BY

JOHN W. GILMORE

It is considered that the activities of this division should be directed along three general lines: First, instruction to regularly enrolled students at Berkeley and at Davis. Second, a line of activities which may be termed, though not administered, as extension work. This comprises correspondence, mainly in answer to inquiries for information on all lines pertaining to crop production, conferences with landholders and students regarding problems and policies of land management and crop production. Third, investigations bearing upon the principles and practices in crop production.

One phase of the division activities, especially in all of its offices, are the conferences. Members of the instructing staff invite students who may want further information upon the subject of their study or information along special lines to come into their office for individual consultation. There are, in additon to this, a considerable number of callers who come both to the offices as well as to the stations for conference and inspection regarding their particular problems.

Investigations.—The investigation and research work of the division is carried on at localities and under circumstances designated as follows:

The University Farm School at Davis, 40 acres, as previously reported, with an addition of 40 acres to be used in dry farming operations during the coming year.

At Kearney Park, 20 acres being a portion of the Kearney Estate.

At Meloland, Imperial Valley, on 40 acres, a gift of the county.

At Berkeley on small areas set aside and in the greenhouses of the division.

At large in several portions of the state chosen for climatic or soil considerations.

In co-operation with the Department of Agriculture at Middle River and at Biggs.

At University Farm, Davis.—It is deemed desirable to consider the experimental grounds at Davis as the principal headquarters for investigational work. At this station investigations are planned to cover in general longer periods of time and as pertaining more particularly to the fundamental principles involved than at the other stations. Davis is, therefore, the principal seat of investigations in the soil, moisture and crop conditions under dry farming methods, also the influence of fertilizers upon soil and crops and the principles involved in rotations, diversifications, and green manuring.

At the present time there are being conducted at the University Farm projects which may be mentioned as follows:

Variety Trials.—The variety trials with cereals are carried on in two groups: (1) Nursery or row planting, and (2) Plat plantings.

The nursery plantings include row trials with 58 varieties of wheat, 38 varieties of barley, and 37 varieties of oats. Besides these, 52 strains of hybrid wheat are being grown, as well as 58 improved strains of wheat, barley and oats increased from centgeners.

The plat experiments include 62 varieties and strains of wheat, 36 varieties and strains of barley, and 18 varieties of oats.

Fertilizer Experiment.—The fertilizer experiment, composed of 27 one-twentieth acre plats, which was originally designed to determine the effect of various kinds and combinations of commercial fertilizers upon the composition of wheat, was continued this season. As is the case with the variety trial, some of the plats suffered from the heavy rain early in the season, so that the stand is not uniform.

Breeding Experiment.—As in previous years, the work of cereal improvement has been conducted largely by the centgener method. While some very good results have been obtained, many of the strains have given very erratic results. In conjunction with this work, it is planned to begin selection from pure strains in comparison with the centgener method. Head selection from field plantings will be made for this purpose this season, as it is thought that this method, permitting the use of large numbers, will be more productive of results.

Rotation Experiments.—The old rotation experiment designed to determine the effect of summer fallow and green manure crop upon the yield of wheat has been replaced by a more extensive project. The experiment as it now stands includes continuous cropping with nearly all dry-farm cereals and forage crops, as well as rotations combining the use of the various cereals, forage crop, green manure crops, and summer fallow. Moisture determination will be made upon the soil of each plat, at given intervals during the season, to ascertain which system of cropping is most economical of water. The first samples for moisture determination were taken March 5th to 10th, following an extremely wet winter, while the soil was nearly saturated; the results showed a marked difference in the water-holding capacity of the various soil strata.

Chemical analysis will also be made upon the soil of the various plats from time to time to determine the effect of the different cropping systems upon the humus content of the soil and the intensity of nitrification. This project is composed of 52 one-twentieth acre plats, the crops on all of which are in good condition.

Climate and Soil on the Composition of Wheat.—Two experiments in co-operation with the U. S. Department of Agriculture and Kansas, Texas, South Dakota and Maryland, designed to determine the effect of climate and soil upon the composition of wheat, are continued. Climate seems to have had the greatest influence on composition, while the soil, especially with regard to its moisture-holding capacity, exerted the greatest influence on yield.

Winter Legumes.—An experiment to determine the comparative value of the various varieties of winter legumes for seed and forage and green manure purposes was inaugurated this season on a somewhat more extensive scale than in previous years. It includes 14 varieties of field peas in plats and 11 in row plantings and 28 varieties of vetch and miscellaneous legumes. In spite of the fact that the heavy rain of the winter delayed seeding, all plats are in excellent condition.

Alfalfa Experiment.—Two small experiments with alfalfa have been started. In the spring of 1913 a breeding nursery was set out. The seed used had been hand picked from promising plants of the leading varieties, namely: Chilean, Turkestan, Arabian, and Peruvian. This season (1914) a few of the Siberian varieties have been added to this list. As soon as the plants reach maturity, seed selection, as well as improvement by vegetative propagation, will be undertaken. The second experiment is designed to determine the effect of commercial culture for inoculating alfalfa seed, and also to determine the effect of winter cultivation of the crop. The four leading varieties given above are being used.

Cow Peas and Beans.—A variety experiment with cowpeas and beans, both in plats and in rows, has been started. The work on the cowpeas will be carried on in the same manner as with the winter legumes. In the case of the beans, plat plantings are being made of the leading varieties of the state. With the other varieties only row trials will be conducted.

Sudan Grass.—The Sudan grass experiment started in April, 1913, through the co-operation with Professor C. V. Piper of the Bureau of Plant Industry, was continued this year. During 1913 the crop adequately demonstrated its ability to withstand drought, as the growth upon the dry culture plats was greater during the latter part of the summer, when the roots had had time to develop, than it was earlier in the season. The yield of hay on the dry culture plats was 3.3 tons per acre and on the irrigated plats about eight tons per acre.

The experiments this season will be conducted along lines similar to those of last year to determine its value both as a forage crop and for seed purposes. Plats are being seeded at various dates, both broadcast and drilled, in rows different widths apart, and both with and without irrigation.

Sorghums.—Owing to the general interest in the various sorghums as grain and forage plants, and to their adaptability to dry farm purposes, extensive investigations have been undertaken with this crop. The project includes plat and row plantings with 35 varieties and strains of grain sorghums, and ten varieties of saccharine sorghums. Some work with the sorghums has been done in previous years, but not of a sufficiently largely scale to furnish conclusive data. Results obtained tend to show that of the grain sorghums the Dwarf Milo and the Sudan Durra, or Feterita, are the heaviest producers of grain.

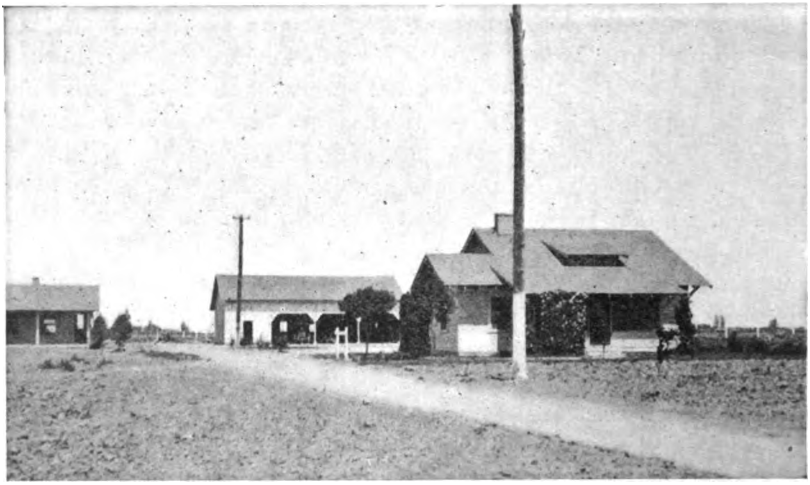
Corn.—The work with corn has been largely in the nature of variety trials. Results of previous years have shown U. S. No. 160, Minnesota No. 13, Leaming & Reid's Yellow Dent to be among the best varieties for this State. The difficulty in the past has been to secure pure seed, necessitating the introduction of new seed each season. It is proposed to overcome this difficulty by hand pollinating enough ears of the most promising varieties to provide seed for the next year's plantings, inasmuch as the success of the varieties often depends upon their becoming acclimated to local conditions. The project includes 46 varieties and a few cultural experiments to ascertain the effect of cultivation and the effect of different rates and methods of planting upon yield.

Potatoes.—In the spring of 1914 work with potatoes was begun, including variety trials, cultural experiments and seeding tests. The results are expected to throw some light upon the varieties best adapted to certain localities of the state as well as to determine the most desirable cultural methods. The laboratory work incident to the experiments, which was formerly done at Berkeley, has been transferred to Davis, the general soil laboratory being used temporarily for this purpose.

At the Imperial Valley Experiment Farm.—Fifteen projects have been approved and fourteen of these have been reported upon. These projects include variety trials of grains and other field crops, rotation and fertilizer trials, irrigation and cultural experiments.

In addition to the above, several projects have been outlined and much work done. Some of these were begun before the new system of projects was adopted and no project outlines are made as yet. They include variety trials of citrus and deciduous fruits (Co-operation between the Divisions of Citriculture and Agronomy); variety trials of grapes and cultural experiments in vineyard (Co-operation between the Divisions of Agronomy and Viticulture); Irrigation Investigations (Co-operation between the Division of Agronomy and the U. S. Irrigation Investigations).

Weather records have been kept since January 1, 1914. These include maximum and minimum temperature records, humidity, rainfall and evaporation readings. The instruments are kept in a standard house built for the purpose.



University of Califorina Agricultural Experiment Station, Meloland, Imperial County, California.

The Experiment Farm is fast becoming a center of interest among the ranchers. The auto stages which pass every half hour make the farm very accessible, and the visitors have very greatly increased during the past year. Over 200 people visited the farm between January 1, 1914, and April 1, 1914. No record was kept prior to that date. The main questions were on soils, irrigation, dates, alfalfa, cotton and fruit in general. In many cases visitors take from an hour to two hours' time. The number of landowners about equals the number of prospective buyers among the farm visitors. The above does not include the inquirers on live stock matters.

Farms were visited upon request when time permitted. Twenty-two farms were visited in various parts of the valley to consider soil problems. In eleven cases soils were tested for alkali and results reported. Two farms were visited to investigate truck garden problems and two for tree pruning.

Institutes.—The plan of holding farmers' institutes in the valley was changed this year, and instead of holding general institutes in the various towns as heretofore institutes were arranged in the various schoolhouses. Seventeen institutes were arranged and held with an average attendance of 37.5 per session. The average attendance of adults was 30.5. The evening sessions proved to be the best by far, the average attendance being 47. In many cases nearly all of the farmers in the district and some from neighboring districts were in attendance, and in every case much interest and enthusiasm was shown. Permanent farmers' clubs were organized in some of the districts where such an organization seemed feasible.

Institutes were held in the following places:

School District	Date	Attendance afternoon Adults	Attendance afternoon Children	Attendance evening Adults	Attendance evening Children
Fern	4/23/14	No meeting		60	2
Mulberry	4/14/14	30		75	
Bard	2/28/14	60		70	
Mt. Signal	2/23/14	13	20	30	15
Meloland	12/13/13	6 (Conflict)		49	20
Alamitos	12/12/13	15	12	29	8
Elm	10/24/13	11	5	19	5
Jasper	10/25/13	No meeting		25	3
Eucalyptus	11/1/13	11	25	41	14
McCabe	11/6/13	19	25	31	5
Wideawake	11/7/13	5	12	13	1
Magnolia	11/13/13	22	18	48	22
Central	11/14/13	34	20	72	30
Eastside	11/29/13	19	20	49	5
Alamo	11/28/13	10		32	
Dixieland	12/6/13	11	5	45	10
Westmoreland	12/-/13	28	15	48	5
		294	177	736	163
		177		163	
	Total,	471		799	

Special institutes were held on the Experiment Farm to cover subjects of particular interest to certain ranchers.

At Kearney Park Experiment Station.—At this station there are five permanent experiments in progress. They were started in 1910, and their value increases with the length of time they are allowed to run. They are as follows:

Rotation Without Fertilizers.—This is a three-year rotation experiment as affecting soil fertility, no fertilizers of any kind being used. Three plots are each planted every year to one of the three crops. They are wheat, sorghum, and roots. This year the wheat plot was planted to Bob's wheat in December. The sorghum plot was planted April 23 to Feterita. The root plot was planted to Long Red Mangels on April 28.

Rotation With Fertilizers.—This is similar in every respect, except that all the plots are fertilized every year, either with stable manure or by plowing under a green manure crop. This year the wheat plot had an application of stable manure, while the sorghum and root plots had cover crops of legumes plowed under.

Annual Versus Biennial Cropping.—This is a fertility experiment in annual versus biennial cropping of wheat. At the present writing there is a visible difference between the two in favor of the biennially cropped plot. They were both planted to Bob's wheat in December.

Cultural Methods.—This is a cultural experiment with two biennially cropped plots of barley. Both are plowed to the same depth of six to eight inches. One is worked down to a seed bed with the harrow only, while the other has a Campbell sub-surface packer run over it at right angles to the furrows, and is then finished with the harrow. Both were planted to Tennessee Winter barley in December. There is no visible difference in the stand at the present writing.

Depth of Plowing.—This is a cultural experiment in deep versus shallow plowing. A biennially cropped plot is plowed to a depth of four inches only, and otherwise treated in exactly the same manner as the plot in Experiment No. 4 without the sub-packer. It is planted to the same crop at the same time also, so that comparison can be made between the two. There is no visible difference in the stand at the present writing.

The permanent experiments have not run long enough yet to warrant any definite conclusions. Last year the annually cropped plot of wheat yielded more than the wheat plot in the three-year unfertilized rotation experiment. The yields in bushels per acre of the wheat plots in the first three experiments last year were as follows:

Three-year rotation, unfertilized	10.22
Three-year rotation, fertilized	24.38
Annually cropped	26.98
Biennially cropped	35.04

In connection with the rotation experiment with fertilizers, thirteen varieties of legumes were planted as a cover crop on one of the plots.

Before plowing under March 20 sixteen feet of one row of each variety were cut close to the ground and weighed green. The names and green weight of each variety are as follows:

Fenugreek	5 lbs.	12 oz.	Lathyrus Cicer	5 lbs.	12 oz.
Lathyrus Sativus	6	14	Lathyrus Tingitanus	5	12
Lathyrus Clymenum	6	13	Lathyrus Coccinus	4	14
Vicia Fulgens	6	12	Vicia Sativa	6	6
Vicia Calcareta	7	4	Vicia Ervilea	5	....
Canadian Field Pea	6	4	Niles Field Peas	11	....
Mexican Field Pea	8	....			

One of the most serious problems of the station is the eradication of Johnson Grass. It is pretty well established all over the thirty acres of the station experimental grounds, and an effort is being made to eradicate it. Different portions of the station will be withdrawn from culture for one year as they can be spared. A weed cutter has been purchased which cuts off the stalks at about two or three inches below the surface of the ground. This will be used on the area set aside every eight or ten days to keep the growth down. This year eight plots are being gone over in this manner. Meantime the Johnson grass on the other portions of the station is being kept down by hand as well as possible.

Another experiment is being conducted this year in co-operation with the Division of Soil Technology. A well or sump fourteen feet deep has been dug and a three-inch centrifugal pump installed. By means of a float switch this pump will keep the water in the well down to a depth of twelve feet or lower. At present the water in the well stands at about six feet from the surface. Sixteen test wells have been sunk radiating out from the sump, the four farthest being 600 feet distant. The depth to the water in these wells will be measured once a week. In this way it can be determined how far reaching is the effect of a pumping plant on the water table.

Other investigations than those already mentioned comprise work being conducted at Berkeley, mainly in the growing of cereals and forage crops in a large number of varieties for classroom material and upon which observations and records of growth are taken.

Preliminary plans have been laid for comprehensive investigations in forage crop and range conditions in several parts of the state. Preliminary arrangements are also made for obtaining from a large number of sources, records and data bearing upon the cost of land management and crop production.

The Division of Agronomy, co-operating in a consulting capacity with the U. S. Department of Agriculture in general cropping experiments at Middle River, which locality represents the conditions existing at large in the delta region is also in co-operation in the same manner with the department in the rice investigations that are being conducted at Biggs.

The dairy herd of the University Farm consists of four Ayrshires, twenty-five Guernseys, thirty Holstein-Friesians, and twenty-one Jerseys.

ANIMAL HUSBANDRY

BY

GORDON H. TRUE

Three members of the division acted as judges at eight different county fairs, a work distinctly educational in its character and much appreciated by the fair managers and people in attendance.

Exhibits of live stock were made at the California State Fair and at the Pacific International Live Stock Show at Portland. At the State Fair, 35 animals exhibited by the division were awarded premiums consisting of 32 firsts, 8 seconds, 5 thirds, 2 fourths, 1 fifth, and 11 championships, or a total of 59 prizes. At Portland 17 animals were awarded 8 firsts, 9 seconds, 1 third, and 5 championships, or a total of 23 prizes. The division feels that in making these exhibits it is not only giving the people of the state an opportunity to judge something of the work of the school and giving its students and employees a needed opportunity for practice in the art of fitting stock for show and of exhibiting the same, but that it is following the best practice of progressive breeders who feel the need of this annual judgment of their work in comparison with that of other breeders, at the hands of skilled and disinterested judges.

During the first nine months of this fiscal year the division has sold 57 head of breeding stock to farmers of the state and referred inquiries to other breeders resulting in sales by them.

No record has been kept of the number of visitors to the division during the year, but probably no less than five hundred persons have come seeking personal advice. The division has tried never to be too busy to give all necessary time to such people, as this appeals to it as being one of the most effective opportunities for service.

The work done in conducting official tests of dairy cows for production of milk and butter fat has been recently added to the duties of this division, Professor F. W. Woll having been placed in charge, with Miss C. J. Hill as assistant. A larger number of tests has been conducted during the current year than in any previous similar period, and new breeders are taking up this testing work each month. The tests are becoming of increasing direct value to the breeders every year, as records of production are more and more being made a condition of purchase of dairy stock, and the prices which stock can command are largely dependent on the records made in tests conducted by the agricultural colleges.

Official tests are conducted in co-operation with the various dairy breed associations and are of two kinds—seven or thirty days' duration, conducted almost wholly with Holstein cows, and monthly tests of two days' duration, conducted with Guernsey, Jersey, and Holstein cows. The large proportion of tests of the latter class which are conducted for yearly records of production, is a most encouraging phase of the work in this state.

The following statement shows the number of breeders for whom tests were conducted during the year, the number of cows tested, and the records of 21 pounds of butter fat or more for seven consecutive days, which were made by California cows during the past year:

OFFICIAL TESTS OF DAIRY COWS, JULY 1, 1913–MAY 1, 1914

	No. of cows on test for period given					
Name and address of breeder	Year	7 days	14 days	30 days	60-100 days	Totals
Ayrshires—						
University of California, Davis	1	....	....	....	....	1
Guernseys—						
W. H. Dupee, Santee	14	....	....	....	....	14
	....	3	....	....	....	3
Holsteins—	15	3	00	00	00	
K. W. Abbott, Milpitas	....	4	....	....	....	4
B. F. Anderson, Modesto	1	1	....	....	....	2
J. W. Benoit, Modesto	1	13	....	....	....	14
H. E. Cornwell, Modesto	....	1	....	....	....	1
J. S. Gibson Co., Williams	....	2	....	....	....	2
R. F. Guerin, Visalia	....	9	....	....	....	9
L. A. Hall, San Jose	4	8	....	....	....	12
Miss M. M. Holdridge, Modesto	....	25	7	....	....	32
Leland Stanford Junior University (Vina Ranch), Vina	....	3	....	....	....	3
M. A. MacLean, Modesto	....	9	....	....	....	9
H. L. Martin, Modesto	....	2	....	....	....	2
E. O. McClure, Modesto	....	3	....	....	....	3
J. McGillivray, Sacramento	....	6	....	....	....	6
A. W. Morris & Sons Corp., Woodland	75	74	3	17	4	173
D. and H. Rowles, Modesto	....	2	....	....	....	2
G. A. Smith, Corcoran	3	3	....	....	....	6
E. A. Stellar (Merci Ranch), Modesto	....	1	....	....	....	1
University Farm, Davis	7	7	....	....	....	14
Watson Bros., Dixon	....	1	....	....	....	1
	91	174	10	17	4	

OFFICIAL TESTS OF DAIRY COWS, JULY 1, 1913–MAY 1, 1914—*Continued*

Name and address of breeder	No. of cows on test for period given Year	7 days	14 days	30 days	60-100 days	Totals
Jerseys—						
X. Carrithers, Tulare	12	....	....	....	....	12
D. F. Conant, Modesto	8	....	....	....	....	8
L. J. Dobler, Turlock	10	....	....	....	....	10
J. A. Goodall, Turlock	2	....	....	....	....	2
W. J. Hackett, Ceres	12	....	....	....	....	12
C. D. Hayworth	10	....	....	....	....	10
G. O. Hillier, Modesto	15	....	....	....	....	15
A. A. Jenkins, Tulare	2	....	....	....	....	2
G. F. Kendall, Ceres	5	....	....	....	....	5
G. McFarland, Tulare	3	....	....	....	....	3
G. H. Miller, Modesto	11	....	....	....	....	11
C. N. Odell, Modesto	12	....	....	....	....	12
J. F. Snover, Ceres	8	....	....	....	....	8
University Farm, Davis	2	2	....	....	....	4
	112	2	00	00	00	

RECORDS OF PRODUCTION MADE DURING SEVEN CONSECUTIVE DAYS

Name of Cow	Age	Milk lbs.	Butter fat lbs.	Butter fat av.%	Owner
Mable Haskins of San Jose Jose 40957	4½	680.1	26.213	3.85	K. W. Abbott, Milpitas
Luit Burke 197331	4⅙	483.3	26.204	5.42	A. W. Morris & Sons, Woodland
Salo Canary Mercedes Burke 129048	4¾	490.7	25.425	5.18	A. W. Morris & Sons, Woodland
Jane Korndyke of Riverside 93925	7	575.8	24.972	4.34	A. W. Morris & Sons, Woodland
Tilly Alcartrs 123459	5¼	715.4	23.412	3.27	A. W. Morris & Sons, Woodland
Wisconsin Daisy of Sleepy Hollow 133794	4½	619.4	23.925	3.86	L. A. Hall, San Jose
Tula De Kol Pietertje Netherland 106233	2	502.6	22.729	4.52	Miss M. M. Holdridge, Modesto
Natula Fobes 2d 152267	3⅓	436.0	22.293	5.11	A. W. Morris & Sons, Woodland
Riverside Sadie Burke 99697	6¾	413.7	22.000	5.32	A. W. Morris & Sons, Woodland
Sleepy Hollow Meditation 110832	5½	651.3	21.151	3.25	Miss M. M. Holdridge, Modesto
Mary King of Riverside 93943	7	408.4	21.128	5.17	A. W. Morris & Sons, Woodland
Wilhelmina Gerben DeKol 103374	4½	444.6	24.341	5.47	A. W. Morris & Sons, Woodland

Experimental Work.

The following investigations conducted by this division have been completed during the year or are in progress at the present time.

Ground Barley as Supplementary Feed to Alfalfa.—The experiment was conducted from July 24 to October 7, 1913, with 14 cows in the University dairy herd. When fed barley in addition to alfalfa hay, the cows produced 16.2 per cent more milk and 13.2 per cent more butter fat than when fed alfalfa hay only. They also gained 12 pounds more per head in body weight when fed barley and alfalfa than during the exclusive alfalfa period. At 16 cents per gallon for milk, $24 per ton for barley and 7 cents per pound for beef, a gain of $35.82 was thus secured, against an outlay of $31.43 for barley. This does not show the entire benefit derived from the feeding of grain supplementary to alfalfa, however, as the improved condition of the cows that came as a result of the grain feeding, doubtless, also had a beneficial influence on their production during the balance of the lactation period and during the next lactation, although no definite statement can be made as to the importance in this respect of the influence of the more liberal system of feeding.

Corn Silage as a Supplement to Alfalfa Hay.—Twenty-four cows separated into two even lots, were included in the experiment which was conducted from November 20, 1913, to March 5, 1914. Six cows in each lot received no grain feed in addition to alfalfa or alfalfa and silage, while the others received abont five pounds per head daily in addition to roughage fed. The feeding of silage resulted in a gain of 22 per cent in milk, 10.8 per cent in butter fat, and 12.3 per cent in milk solids. At average prices for feed and products, the increase in production more than paid for the excess of feed eaten during the silage periods.

Metabolism of Fresh Milch Cows.—The investigation has so far been confined to a study of the relation between the body weights of fresh milch cows and the fat contents of their milk for two to three weeks after freshening. Six cows have been included in the trial so far. They have been weighed twice daily during the period given and the separate milkings have been tested for butter fat and solids. The investigation will be continued during the year with a view to determining the conditions under which certain cows may yield milk of abnormally high fat content immediately after freshening, and the relation between their body weights and the per cent of butter fat in the milk.

The Effect of Alfalfa as Exclusive Feed on the Development of the Dairy Cow and Heifer.—Six calves have been included in this investigation so far, and two more will be added in the near future, so that four heifer calves will be fed green alfalfa or alfalfa hay and four will receive mixed rations consisting of alfalfa and grain feeds with corn silage during the winter. Each lot consists of pure-bred representatives of the Jersey, Guernsey and Holstein breeds and one Shorthorn grade. The feed eaten by the calves will be weighed daily and careful records of their weights and growth as determined by measurements will be kept.

The Efficiency of the Hinman Milking Machine.—Sixteen cows in the University dairy herd were milked with the machine during four weeks from March 5 to April 2, 1914, and their production was compared with that during the preceding and following two-week periods, when the cows were milked by hand. Both machine-drawn milk and strippings were analyzed separately and observations of the time required for the machine and hand milking were also taken. The average time required for milking cows by machine was 10.9 minutes and .78 of a pound of milk was obtained per minute (strippings included). The corresponding data for hand milking was 4.3 minutes and 1.78 pounds. The cows produced 8.2 per cent less milk and 6.7 per cent less butter fat on the four-week period of machine milking than on the preceding and following two weeks of hand milking. On the average for the different cows, the machine left 1.2 to 6.8 pounds of strippings per day to be milked out by hand, containing 11.8 to 66.4 per cent of the total amount of butter fat produced by the cows; the average for all cows, 3.5 pounds strippings per day and 37.2 per cent of the total fat in these.

Cost of Hand Milking and Machine Milking in Commercial Dairies.—Data for only one dairy, Watson Bros. of Dixon, has been obtained at this time. Sharples Mechanical Milker was installed in this dairy about February 20, 1914. Time observations and weighings of milk were made on February 15 and on March 29 for machine milking. The average time for milking per cow by hand milking (3 men) was 6.79 minutes and on machine milking (2 men, 1 running 4 units and the other stripping) was 1.74 minutes; weight of milk per minute by hand milking 4.74 pounds, machine milking 6.23 pounds.

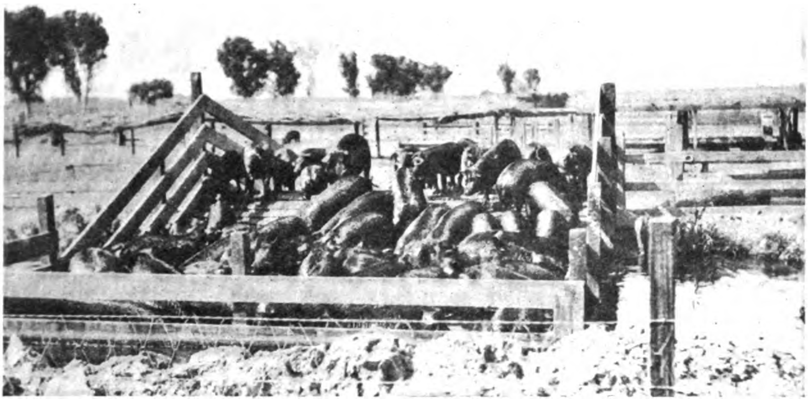
On the Value of Grain Feeds for Goats Fed Alfalfa.—Four milch goats loaned to the University by Mr. Winthrop Howland, of Redlands, Cal., a breeder of Toggenburg goats, are used in this experiment.

The goats kidded as follows: Delia, one-half Toggenburg, February 20, triplets; Geneva, pure bred, March 11, twins; Hedda, pure bred, April 11, triplets; and Delphine, three-fourths Toggenburg, April 12, twins. Two of the goats are fed green alfalfa or alfalfa hay only, while the other two receive grain feed in addition to the alfalfa. The production of milk, butter fat and solids by the goats is determined by regular weekly composite sampling and testing, as in the case of the cows in the University dairy herd, and the feed which they receive is weighed except when pastured. The investigation will be continued for at least a year.

Feeding Beet Pulp with Various Supplementary Feeds at Gilroy, Cal.—(In co-operation with Miller & Lux, Inc.) From December 23, 1913, to February 10, 1914, four lots of twenty-five steers each were fed as follows: Beet pulp all they would eat, and to lot I 15 pounds alfalfa hay, to lot II 20 pounds alfalfa hay, to lot III 7½ pounds barley hay. This lot made the largest gain; lot IV, fed rye grass hay and 2 pounds horse beans daily with beet pulp, made the second largest gain; there being but little difference in the gains made by lots I and II.

Feeding of Various Grains in Connection with Alfalfa Hay for Range Steers at Lovelock, Nev. (in Co-operation with Western Meat Company).—The object of these trials was to study problems connected with feeding of grain feeds to steers fed alfalfa hay under range conditions. The feeding trials were conducted October 30, 1913, to March 21, 1914, and included about 2000 animals in all, the number of steers in the different lots ranging from 199 to 236, with an average of 226 steers per lot. One lot also included 101 hogs following the steers and fed corn separately. The following grain feeds were fed supplementary to alfalfa hay: shelled corn, dried beet pulp, barley, Sperry Feed ("Sure Milk"), and cotton seed cake. The hay fed was chopped in all lots but two, which received long hay. The trials involved the feeding of over 1900 tons of hay and 550 tons (about 20 carloads) of grain feed in all, the total cost of the feed eaten by the steers exceeding $31,000.

Owing to the fact that the trials were brought to a close on different dates during January to March, 1914, and that the weather and other conditions varied greatly during the progress of the trials, it is not possible to make strict comparisons between the nutritive values of the different grain feeds in all cases, but most valuable results were nevertheless obtained on these trials, which are unique on account of the large scale on which they were conducted and the variety of conditions covered by them. The best returns were obtained with barley and alfalfa hay, the average daily ration fed being 5.5 pounds of barley and 21.8 pounds of hay. The returns from the rations including Sperry's Sure Milk, beet pulp and corn decreased in the order given.



Watering place for hogs. Note the sheds for shade in the distance. They should be placed at a distance from the water to prevent the formation of mud-holes under them.

The Use of Supplemental Feed with Barley for Pork Production and the Comparison of Lard Hogs with Bacon Hogs for the Production of Bacon.—The experiment was conducted for 70 days during the summer of 1913, with five lots of 15 hogs each, four of which were mixed lots of Poland Chinas, Berkshires and Duroc Jerseys, and the fifth was Tamworths only. All lots were fed barley, which was the sole feed for lot I, and the other lots received in addition: Lot II, alfalfa pasture; lot III, alfalfa pasture and shorts; lots IV and V, alfalfa pasture, shorts and skim milk. The first four lots, which averaged 76 pounds each at the beginning of the experiment, made the following average daily gains per head: .75, .81, .85, and 1.27 pounds for lots I to IV respectively, while the pigs in lot V, which were thirty days older than those in the other lots and averaged 114 pounds each, gained 1.57 pounds daily.

Soiling vs. Pasture as Supplements to the Grain Rations for Pigs.—Fifteen 4½-months-old shoats, averaging 114 pounds at the beginning of the trial, have been fed barley in addition to green feed since February, 1914, one lot being on alfalfa pasture and the other being fed green alfalfa. The area of the pasture eaten by the hogs is measured and the green feed is weighed and the area likewise measured The results obtained up to the present time (April, 1914) did not indicate any appreciable difference in the gains made by the two lots.

Gifts.—From Mr. Allen A. Chickering, executor of the estate of Minna E. Sherman, a set of 28 volumes of the Holstein-Friesian Register, 12 volumes of Advanced Registry of Holstein-Friesian cattle, 6 volumes of the Holstein-Friesian Year Book. These books are presented as a memorial of Mrs. Minna Eschleman Sherman, for years a leading breeder of Holstein-Friesian cattle, and at the time of her death a Regent of the University of California.

Pens for brood sows and their litters. The roof is of chicken wire covered with hay, an effective protection for hogs in Imperial County.

From the various registry associations the following:

American Shetland Pony Stud Book, Vols. 1–12.
National Register of Belgian Draft Horses, Vol. 1.
American Yorkshire Record, Vols. 1–4.
American Chester White Record, Vols. 5 and 6 and 8–17.
American Southdown Record, Vols. 1–9.
American Oxford Down Record, Vols. 11–12.
Jersey Herd Register, Vols. 59–78.
American Polled Durham Herd Book, Vol. 5.
American Aberdeen Angus Herd Book, Vol. 22.
Holstein-Friesian Herd Book, Vol. 31.

American Hereford Herd Record, Vols. 37 and 38.
American Guernsey Herd Register, Vol. 12 and 20–26.
American Berkshire Record, Vols. 42–44.
National Duroc Jersey Record, Vol. 44.
American Shorthorn Herd Book, Vols. 79 and 80.
Standard Poland China Record, Vols. 32 and 33.
American Poland China Record, Vol. 62.
National Poland China Record, Vols. 28–33.
Ohio Poland China Record, Vols. 21–23 and 25–27.
American Saddle Horse Register, Vol. 5.
American Shropshire Sheep Record, Vol. 23.
American Hampshire Record, Vol. 6.
American Tamworth Record, Vols. 1–3.

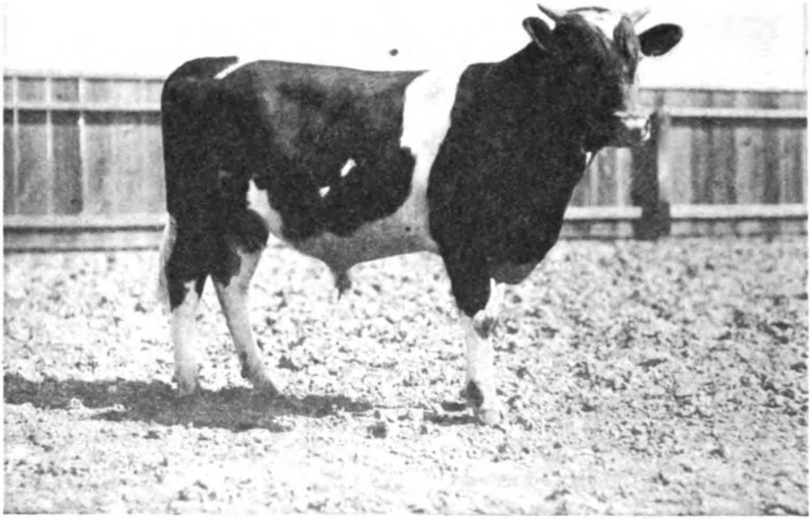
Toggenburg milch goats owned by Winthrop Howlands, California, used to determine the relative cost of milk from goats and cows.

Loan.—Mr. Winthrop Howland, breeder of Toggenburg milch goats, Redlands, Cal., has loaned us four does, two of which are pure-bred Toggenburgs and two grades, to be used in experimental work to determine the relative cost of milk production by goats and cows.

This division has loaned to the California Polytechnic School at San Luis Obispo, for a period of one year, a pure-bred Holstein-Friesian bull, Teake Lyons Pontiac Segis, No. 119322, value $350.

For the fiscal year the sales of the division have amounted to the total sum of $16,993.65. Of this amount, $2990.35 has been received for milk and cream, $4756.35 from the sale of dairy animals, $3670.44 from beef animals, $3520.51 from hogs, $445.65 from sheep, $500 from horses, other receipts $1110.35.

During the year the live stock equipment has been increased by the addition of 25 head of Guernsey cattle, four Jerseys, three Ayrshires and one Holstein. The Guernseys constituted the herd of Mr. J. H. Mackenzie of Yuba City, and nine were bulls, three of which have been sold. The four Jerseys were yearling heifers from the Meridale herd of Ayer & McKinney, Meredith, New York. The Ayrshires purchased consist of a young bull, a cow and heifer from the herd of J. W. Clise, Redmond, Washington. The one Holstein-Friesian purchased was from the Minnewawa herd of the late Mrs. M. E. Sherman of Fresno.

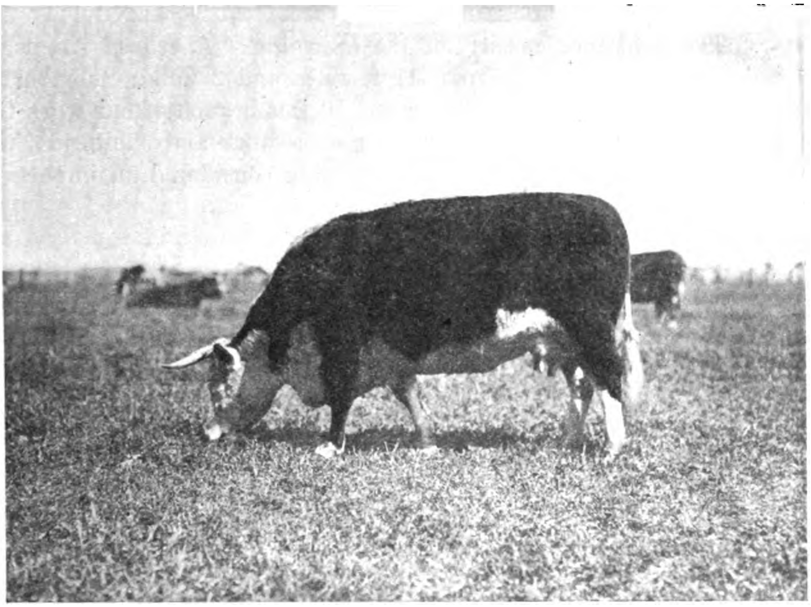


Guernsey bull calf, University Farm. Winner at Pacific International Live Stock Exposition, Portland, 1913.

Of the members of the dairy herd, 28 have been used in experimental feeding during the year. Complete records of production are now being kept of all cows in milk. During the year eight have been admitted to Advanced Registry on seven-day records, as follows:

	Lbs. Milk	Lbs. Butterfat
Brown Bessie's Gaylark, No. 218062, Jersey	344.9	19.7
Mermaiden's Fern, No. 269301, Jersey	279.9	16.5
University La Polka Lady, No. 217774, Holstein	419.8	14.51
Queen of Hopland, No. 98928, Holstein	404.3	14.11
Korndyke Senorita, No. 194170, Holstein	427.9	14.54
Colantha 4th's Lad Mercedes, No. 118898, Holstein	437.3	15.16
Agnes Colantha, No. 169993, Holstein	303.6	10.35
Roxey Mercedes Queen II, No. 144605, Holstein	339.2	13.54

Two official years' records have been completed. Pietertje Bloom, No. 66816, a Holstein-Friesian cow eleven years old, that made an unofficial yearly record last year of 783 pounds of butter fat, has this year given 21,415 pounds of milk and 654 pounds of butter fat. Her two-year-old daughter, Pietertje Bloom 2d, No. 169995, has made the satisfactory official year's record of 13,501 pounds of milk and 473 pounds of butter fat. Thirteen cows of various pure breeds are now being tested for advanced registry.



Hereford cow, University Farm.

The dairy herd to date consists of the following: Ayrshires, 2 females and 2 males; Guernseys, 17 females and 8 males; Holstein-Friesians, 23 females and 7 males; Jerseys, 19 females and 2 males.

The hog herd has been added to by the purchase of a boar and two sows of the Chester White breed, three Poland Chinas, two Berkshires, three Duroc Jerseys and a large Yorkshire sow. The present breeding herd consists of the following: Berkshires, 24; Duroc Jerseys, 28; Poland Chinas, 29; Chester White, 3; Yorkshires, 1; and Tamworths, 4.

The breeding herd has been seriously weakened by the loss of some of the best brood sows from tuberculosis, apparently due to the feeding of unpasteurized skim milk. In all 14 sows have reacted to the tuberculin test and of these two have been lost. Thus far there is no indication of disease in pigs sucking the sows at the time they are supposed to have contracted the disease.

The sheep flock has been increased by the purchase of four Cotswolds, three ewes from the flock of Riddell & Sons, and a ram from F. A. Koser of Oregon. The present stock consists of 17 Shropshire ewes, 3 rams and 4 wethers, and 51 lambs of the various breeds. Of the 45 ewes bred this season, 34 raised 51 lambs, a satisfactory increase of 150 per cent.

No additions have been made to the beef cattle herd during the year. The herd now consists of the following: Aberdeen Angus, 8 females and 1 bull; Herefords, 11 females and 2 bulls; Shorthorns, 6 females and no bulls, and 13 steers. In this branch of our work the aim is to produce high-class steers for class work and exhibition, the growing and exhibition of these cattle being considered an important part of our educational work.

CITRICULTURE

BY

J. ELIOT COIT

During the first year after organization the members of the Division of Citriculture have found it necessary to devote most of their energies toward the establishment of courses of instruction at Berkeley. This proved no light task in view of the fact that there existed no textbooks, laboratory, nor field equipment. During the year two main courses and four subsidiary courses have been established, the laboratory has been equipped with apparatus and illustrative material, and a good beginning made toward a division herbarium, museum, and library.

At Davis.—A course in citrus and semi-tropical fruits has been established at Davis and a beginning made toward a plantation of semi-tropical fruits. It is the intention to include in the orchard specimens of all varieties of citrus and semi-tropical fruits which the climatic conditions at Davis may permit, the plantation to furnish laboratory and illustrative material for use both at Davis and Berkeley.

A Study of the Factors Influencing Seed Formation in Citrus Fruits.—From the work already done it appears that:

1. In all naturally fertile varieties of orange trees, self-pollination is the rule and cross-pollination is unnecessary. The activity of insects is not needed for such varieties to set fruit.

2. Viable pollen of parthenocarpic varieties is either entirely wanting or is very scarce. It is thus characteristic of parthenocarpic trees to bear fruit without pollination.

3. The time required for complete fertilization after pollination varies with the variety from thirty hours in the Satsuma orange to four weeks in the trifoliate orange.

4. Disintegration of the embryo-sacs sometimes takes place in the Washington Navel and Satsuma oranges. It may occur before the formation of the megaspores, but usually not until afterwards.

5. Some normal embryo-sacs are produced in occasional fruits of both Washington Navel and Satsuma oranges. Thus a few seeds may be produced, provided these particular fruits happen to be pollinated

with viable pollen from fertile varieties. It is the remoteness of the chance of this occurring under ordinary field conditions that accounts for the seedlessness of these fruits.

6. There appears to be nothing in the structure of the flowers of either the Washington Navel or the Satsuma oranges which would interfere in any way with the germination of pollen or normal extension of the pollen tube.

7. Parthenocarpic citrus varieties are probably hybrids between naturally fertile varieties.

The Loquat.—The loquat has been commonly planted as a dooryard tree in California for many years. Most of these trees are seedlings which produce only mediocre fruit. All such trees should be topworked to improved varieties. In the future only budded trees of good varieties should be planted.

Either quince seedlings or rooted quince cuttings may be used as a stock. The fruits of the new improved varieties are well worthy of extensive cultivation. An active market demand has appeared wherever good fruits were available.

On account of the climatic requirements of the loquat, its culture on a commercial scale is limited to the more frostless belts and localities where winter rains are not too continuous to prevent pollination and setting of fruit.

DAIRY INDUSTRY

BY

L. M. DAVIS

The Educational Butter Scoring Contest is now in its sixth year. During 1913 fifty-one buttermakers in the state took part in the contests. The co-operation of the United States Dairy Division and the official Butter Inspector of the San Francisco market has been greatly appreciated in this work. The rules for 1913 provided for certain prizes and certificates, which were won by the following contestants:

For highest average score during the year—
  Victor Baciarini, Suisun, California—Engraved loving cup—Score, 93.75.
For second highest average score during the year—
  Peter Peterson, Loleta, California, and Hans L. Beck, Fresno, California, tied—Engraved loving cups—Score, 93.29.

Certificates of merit were also awarded to these contestants. The first entry for 1914, held March 7, resulted in twenty-seven buttermakers participating. The butter judges for this year are Mr. T. J. Harris of San Francisco, Mr. H. S. Baird and the writer, of this division.

The Chief of the Division served as Superintendent of the Dairy Building at the State Fair, the operation of the working creamery being under our direction. Many dairymen take advantage of our willingness to test samples of milk and cream and 269 samples have been tested for butterfat content the past year. Aside from this, seventy-five samples of butter, largely in connection with the Scoring Contest work, have been analyzed for moisture and salt. The division has been called upon by the United States Dairy Division to supervise the inspection of navy butter manufactured in California, and Mr. Douglass is at present engaged in this work, being assigned to Ferndale, California.

The following gifts and loans have been made to the division:

1 Acme De Laval Turbine Separator—De Laval Dairy Supply Co., San Francisco.
1 No. 15 De Laval Hand Separator—De Laval Dairy Supply Co., San Francisco.
1 Disc Continuous Ice-cream Freezer—De Laval Dairy Supply Co., San Francisco.

1 No. 5 Simplex Hand Separator—D. H. Burrell & Co., Little Falls, N. Y. (Baker & Hamilton, Agents, San Francisco).
1 No. 15 U. S. Hand Separator—Vermont Farm Machine Co., Bellows Falls, Vt.
1 No. 6 U. S. Hand Separator—Vermont Farm Machine Co., Bellows Falls, Vt.
1 No. 10 Sharples Turbine Separator—Sharples Separator Co., West Chester, Penn.
1 Jersey Hand Separator—Sharples Separator Co., West Chester, Penn.
1 No. 42 Empire Hand Separator—Empire Cream Separator Co., Bloomfield, N. J.

The business of the University Farm Creamery has lately taken on a steady growth. Milk and cream are now received from eighty-three dairies. The following brief report of the amount of business done will serve to show the volume of the commercial work:

BUTTER FAT RECEIVED FOR THE YEAR ENDING JUNE 30, 1914

July, 1913	10,954.10 lbs.
August, 1913	10,254.52 lbs.
September, 1913	9,138.96 lbs.
October, 1913	8,324.95 lbs.
November, 1913	8,165.03 lbs.
December, 1913	9,330.72 lbs.
January, 1914	9,342.98 lbs.
February, 1914	8,233.37 lbs.
March, 1914	12,968.19 lbs.
April, 1914	15,201.31 lbs.
May, 1914	14,315.19 lbs.
June, 1914	12,531.27 lbs.
Total	128,760.59 lbs.

Gallons of milk bought	29,036
Pounds of butter sold	158,440
Pounds of cheese sold	1,095
Gallons of icecream sold	1,596
Gallons of market milk sold	12,417
Gallons of sweet cream sold	224
Pounds of buttermilk sold	366,892
Gross income	$55,191.48

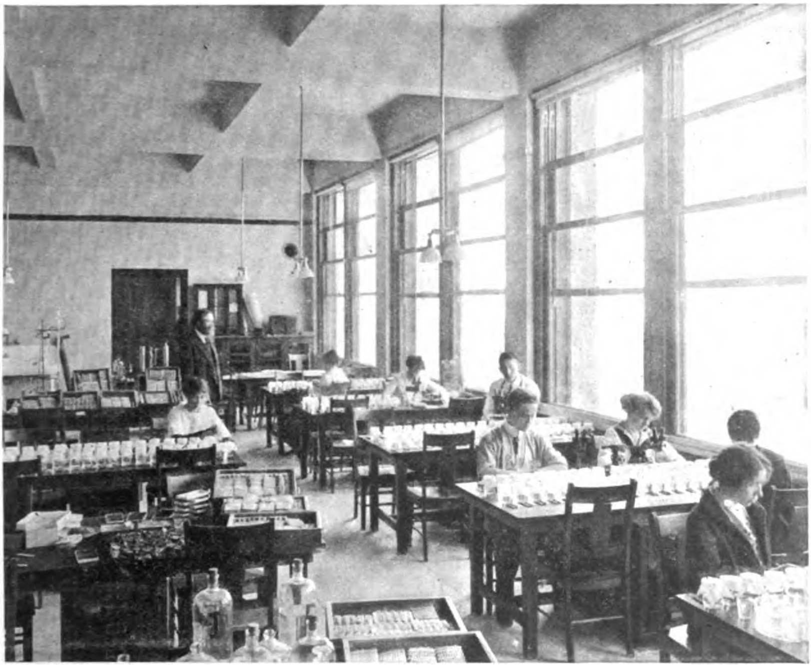
Dairy Building Repairs.—During the year improvements have been made in the Dairy Building. The stairway was changed and several partitions taken out, thereby increasing the floor space in the creamery, cheese and ice-cream rooms by some seven hundred square feet. This additional space has aided materially in handling the large laboratory classes. Two new combined churns, a small power ice-cream freezer, and three new cheese vats, besides other necessary equipment needed in the conducting of the commercial work, have been purchased during the year.

ENTOMOLOGY

BY

C. W. WOODWORTH

Instruction.—It was thought a year ago that the class work might be diminished as the result of the reorganization of the curriculum of the College of Agriculture. There has been no appreciable change, however, in this respect and the departure of Mr. Bridwell simply increased the work of the other members of the staff, as did also Professor Quayle's absence during the first half-year. I have personally shouldered much of the added work. This has involved no special hardship, but has interfered with research work.



Experiments with insecticides must be conducted in long series with many repetitions. Sixty thousand lots of scale insect eggs were used in the cyanide experiments this season.

Research.—The added work in instruction referred to above has prevented the degree of activity in pursuance of the research work that was desired.

Work at Davis.—This year entomological work was inaugurated at the University Farm by the assignment of Mr. Nickels as resident entomologist. A small building has been erected on a plot of ground assigned to this division and a beginning made in a plantation of bee plants, of insecticide plants, and of silkworm food. The larger portion of the University Apiary was transferred to Davis, and at this point will be accumulated the equipment for the advanced work in apiculture.

Some of the striking results of work of this year and new methods of study worthy of especial attention are presented below:

Silkworms.—That which received the greatest amount of popular appreciation was the inauguration of a study of the problem of the production of silk in California at a cost which will make it a profitable crop. Here, as in most other animal industries, the cost of labor in the production of food or in the care of the animals is the controlling factor determining the profitableness of the undertaking. The way silkworms have been grown for many hundreds of years they have required a much larger number of hours of labor per dollar of gross income than any other important animal product, and there has been no great improvement in this respect from the very earliest times.

As long as this continues we will have to send out many millions of dollars to other countries each year for our silk supply. The investigations undertaken include two efforts to accomplish a cheapening of the process. The pasturing of the worms and the development of a race not dependent on the mulberry. Very little progress was made along the first line, most of the attention being given to a study of the possibility of obtaining other food which can be grown and handled more cheaply than mulberry. As was expected, no new plant was found that could be at once substituted for the natural food of this worm. Most races would accept an occasional meal of a variety of plants. The worms of some races would eat more at a time, eat a greater variety of plants at more frequent intervals than others, and often the better adaptability would be shown in two or in all three respects. No existing race among the very large number tested show sufficient adaptability to give hope of practical results without resorting to the breeding and selection work which has been started.

The actual cause of death in the case of those feeding on poison oak was apparently the toxic quality of the plant. Many silkworms fed freely on this plant and died so quickly and uniformly that there seemed no other explanation. In all other cases the death resulting from the feeding of other plants than mulberry was apparently due either to starvation (only in the case of very young worms) or to bacteriosis. The infection by bacteria apparently began in the digestive tract and reached the circulation before death ensued. Exactly the same symptoms occur in worms fed exclusively on mulberry when the temperature is too low, when feeding is scant or irregular, or when the food is collected or fed wet. All writers on silk culture have insisted on the necessity of proper temperature and abundant regular feeding with dry leaves to avoid the death of the worms. The problem of a substitute food is, therefore, the development of a race which will accept freely enough of the new food to escape the fatal infection of the alimentary tract.

Spraying vs. Bees.—Ever since spraying has been recommended for the prevention of codling moth injury, there has been more or less insistence upon the filling of the blossom cup of the apple with the spray, and from the first there has been more or less fear expressed as to danger that might follow from the use of the poison. This was early allayed as far as concerns the danger from the consumption of the fruit by carefully conducted tests and experiments, but there remains a very prevalent belief that this practice is fatal to bees and liable to poison people consuming honey if the spray is applied before the blossoms have ceased to produce nectar. For this reason the published directions for spraying almost universally insist on the delay of spraying till the petals have fallen, and in several states the spraying of trees in bloom is a penal offense. It appears that this general fear is not based on experimental data.

We pointed out ten years ago that in the Pajaro Valley the fruit that sets may be wholly that from the first blossoms and that this fruit may be already as large as cherries before the larger part of the blossoms fall and that, to poison the blossom cups of the fruit, the spray would have to be applied before full bloom. It was not necessary at that time to take up the question of the possible danger to bees, since the most satisfactory spraying practice was found not to require early treatment. Recent studies by Mr. Volck of this department have shown the desirability of a spray during blossoming for other purposes and thus raises the question, though there have never been many bees in the valley.

A hive was shipped from the University apiary at Berkeley to Watsonville and placed in a tree in the center of a forty-acre apple orchard just before spraying with an unusually heavy dose of arsenicals as the trees were just coming into full bloom. The hive was selected by Mr. R. W. Brown, Assistant in Apiculture, and carefully examined by him before and after shipment to Watsonville. He was unable to find any evidence of the poisoning of bees or brood. On the return trip the hive was kept closed until enough dead bees had accumulated for analysis and samples of the pollen and of newly stored honey were also analyzed by Mr. G. P. Gray with negative results in the case of the latter. An amount of arsenic was recovered from the dead bees nearly approaching a toxic dose. All clearly showed that even under the severe conditions of the excessive dose and a locality where practically all the food was from sprayed trees there was no appreciable danger to man from poisoned honey. When the more soluble arsenicals were in use, there is reason to believe that many bees were killed, and even with the insoluble lead or zinc compounds now in use a small percentage evidently die of the poison.

Factors in Longevity.—Mr. J. P. Baumberger, an assistant in the department, has obtained very interesting results in a series of experiments to determine the effect on longevity of a variable temperature as contrasted with one held practically uniform. He found that when insects are exposed to an unusual temperature, either hot or cold, for two days, they live longer in any other temperature than when placed directly in that temperature. It would seem that the physiological disturbance set up by this preliminary treatment results in conditions that require longer to go through than the processes of senescence that finally results in death. It is probable that temperature is only one of the means of so upsetting the physiological balance as to affect longevity and that we have the suggestion of a law that may be of highest significance to students of the action of insecticides in the interpretation of their experimental data.

Cyanide as a Soil Fumigant has been discussed for years, but has never been brought to the stage where a dose or method of procedure could be given. Mr. E. R. Ong, an assistant in this department, has undertaken extensive experiments, under my direction, to determine the action of cyanide gas in the soil. The method devised consists of the use of a series of tubes in the soil through which air could be extracted and the amount of hydrocyanic gas quantitatively determined by the iodine test developed last year in the experiments with scale insect eggs. The plan for obtaining the air samples finally developed consisted of a tube of quarter-inch gas pipe closed below by an iron rivet. After driving the pipe into the ground, a rod was used to drive the rivet a little deeper, thus opening a way for the gas to enter the pipe. Then a glass tube was inserted into the pipe, the lower end nearly touching the rivet. The upper end was provided with a rubber stopper and a short piece of large tubing connected the end of the gas pipe and the stopper. Air was drawn out of the soil by the use of an aspirator which measured the quantity after it had bubbled through the iodine solution and given up whatever cyanide that may have been present.

In order to drive the pipe straight into the soil and prevent air from the surface going down the outside of the pipe, it was held steady when driving by an apparatus consisting of three pieces of three-quarter inch pipe attached together with a four-way tee holding the three pipes 90 degrees apart. The operator stands on two of these and the quarter-inch pipe is inserted in the third, which stands vertical. The style of hammer used for soil tubes is employed for driving. For removing, a heavy wire hook is caught into a quarter-inch hole previously drilled through the pipe about an inch below the end. A block and tackle arrangement is used to lift the pipe. This is supported by a pipe attached to the apparatus used as a guide for driving.

The results obtained were positive and definite. Where the cyanide gas was pumped into the soil within a foot of the sampling tube, only a very small fraction of 1 per cent was recovered. The soil evidently filtered out the gas, either by absorbing or decomposing it. To determine the capacity of the soil in terms of cyanide loss, calcium chloride tubes were then employed holding 50 cc. of soil, and gas of known strength pumped through and it was found that before any considerable quantity of cyanide could pass, the soil had taken nearly its full capacity, which was found to vary from .03–.012 grams per litre, or 122–440 pounds of sodium cyanide per acre foot.

While this amount makes the cost prohibitive for large use, it is well within the possibilities for soil fumigation of small areas, and indeed is only a little more expensive than carbon bisulphid in clayey soils, and much cheaper in sandy soil and in any soil if the fertilizer value of the nitrogen in the material is deducted.

The dose will have to be regulated by the character of the soil, since no results will be produced until after the soil has received the full amount which it can absorb or decompose. The amount to be effective after this saturation point has been reached is very small and it remains to be seen whether this can be so regulated as to be safe on plant tissue.

Another possible outcome of these experiments may be that in cyanide gas may be found a very significant index of clay colloids in soil, since there was such a decided difference in favor of clay soils.

New methods of studying the action of cyanide gas on scale insect eggs were employed this year with very satisfactory results. There is a very short season when work can be done, but the new methods have enabled us to obtain data on about thirty thousand layings. Each laying averaging perhaps five hundred eggs was divided into two lots, one of which was kept as a check and the other treated with cyanide gas.

Data were secured on the following points:

1. Susceptibility of five different species of scale insects.
2. Differences due to locality—eight widely separated localities covering over half the length and width of the State.
3. Differences due to age—continuous collecting in the same locality throughout the egg period.
4. Differences due to preliminary cooling.
5. Differences due to exposure to preliminary degrees of humidity.
6. Rate of gas diffusion.
7. Difference in production of gas.

The most emphasis was given to the new line of investigation concerning the effect on the toxicity of cyanide gas resulting from a preliminary exposure to different degrees of humidity.

The method adopted for securing the varying humidities was by the use of mixtures of sulphuric acid and water in a dessicator; the following densities were selected, giving approximately the humidity indicated:

Per cent	Density	Per cent	Density
0	1.840	50	1.334
10	1.604	60	1.273
20	1.530	70	1.206
30	1.470	80	1.130
40	1.400	90	1.070

The eggs we exposed for different lengths of time up to two days in these dessicators and then one lot from each was given a treatment for a certain time in a series of strengths of gas, the corresponding check lots containing eggs from each of the same scales being taken from the dessicators at the same time, but not given the cyanide treatment. Usually twelve hundred lots were run in the dessicators at one time, of which six hundred are subsequently treated in cyanide in six different time intervals and ten dilutions of the gas. One lot in each set of ten that have the same strength of gas and length of exposure comes from each of the dessicators; thus every lot has a different treatment.

The practical results from this whole series will be the answering of the question whether the dose used in fumigation should be graduated according to the degree of humidity preceding the treatment, which is subject to a very wide range. Thus far fumigators believe that extreme weather conditions of any kind at the time of fumigating are liable to affect results, though in practice they do not usually stop unless the wind is strong enough to make the handling of the tents uncomfortable, or the accumulation of moisture makes the tents too heavy to handle. For theoretical reasons it seems that the condition of the preceding day or two might require a change of dose to secure uniform results, and these experiments should give a definite and final answer.

The method of handling and keeping records on such a large number of experiments required the development of a system which may be of interest to other investigators.

The best container for such material as scale insect eggs is the common gelatin capsule. We use size 0, ten of which lay side by side and occupy just three inches in width. These are assembled in brass staining trays and a three-inch piece of lantern slide binding tape is attached to the covers. After the gum on the tape is dry, the longer inner parts of the capsules are removed and the tapes with their attached rows of covers are clipped at one end to identify them and arranged in pairs in pasteboard trays 3½ × 6¼ × ½ inch, holding just twenty strips. These are then stocked with eggs by taking one by one the inner portions of the capsule and using it to pry off and receive a scale insect with its eggs. This is then jarred till the eggs are all out from beneath the body and the insect is then dexterously poured out and about half of the eggs are then emptied into a second container. The two are then placed adjacent to each other, mouth up, in the corresponding covers on two tapes in the tray. When the two hundred capsules are thus filled, they are ready for treatment and constitute one set.

Treatment with cyanide gas is effected by suspending the strip of ten capsules near the top of a tumbler, using the "gem" paper fasteners, bending one end out as a hook and forcing the remaining loop sidewise so that it will hold steadily against the edge of the glass. In the glass a solution of hydrocyanic acid gas in water maintains a density of gas in the air above, varying with the strength of the solution and the temperature. The cover consists of a piece of thin paraffined paper held on by a rubber band.

A stock solution of hydrocyanic acid is made up fresh each day and from this a series of dilutions are made for each set.

The routine is as follows: A crystallizing dish of a size that will just hold a circle of nine whisky glasses is chosen and the glasses are filled with water. Two glasses with the stock solution are placed in the center, a small lipped beaker completes the outfit. The capsules containing the eggs to be tested are in place in ten tumblers. One person pours one glass of stock solution into the beaker and then pours it carefully into the first tumbler, being careful not to spatter the capsules. Another immediately places on the paper covers. The first person then pours the other glass of stock solution into the beaker and one of the glasses of water and after filling the glass with the mixture pours the rest into the second tumbler. The glass containing the mixture is then poured again into the beaker, together with another glass of water and the process continues as before. This routine is followed until the ten glasses contain each a whisky glass of solution containing percentages of hydrocyanic acid varying from the strength of the stock solution at one end to one five hundred and twelfth as much at the other.

Each set of checks is kept outside the tumbler containing the specimens being treated. The capsules are closed, usually before the treatment is started in the case of the checks, and after adequate airing for those coming from the treatment chamber. Finally all are attached to three by five cards by rubber bands, the checks on one side and the treated specimens on the corresponding position on the other side. Two cards are required to hold the two hundred capsules of a set. The record card is held between the two capsule covered cards also by rubber bands. Each record card contains two hundred spaces on which to record the hatch. Our experience has shown that nearly 100 per cent of the checks hatch, but there are occasional exceptions, making it desirable to have checks in all cases. The capsules can be examined under a binocular without removing them from the cards.

These experiments conclude a series extending over three years which will now be ready to put in form for publication.

Parasitology.—Sanitary surveys, mosquito surveys, and fly surveys have been made in Bay Point, Redwood City, Coronado City, and Atherton. Active control work has been conducted in various localities, covering periods of several days to several months. Ordinarily graduates are employed by the communities or individuals concerned. Special lectures on rural hygiene and sanitation have been given in many communities. Ordinarily the community is visited early enough in the day to permit of a careful inspection of the locality concerned. The members of the board of health, town officials, and committees are met in the afternoon and are given specific advice. The evening is devoted to a public meeting. The organization in charge does the necessary advertising, furnishes the hall and lantern if an evening lecture; otherwise enlarged photographs are used.

Insecticide Work.—Because of the change in the insecticide law the work of the laboratory was changed this year by the elimination of the greater part of the routine analysis and the concentration of the attention upon important problems, the most important of which has been the completion of the study of Phenolic insecticides and fungicides, a class of substances rarely recommended by entomologists and very extensively sold as proprietary articles.

A beginning was made in the revision of the methods of examination of insect powders, another group of preparations having large sale and without recognized standards. The number of routine analyses for the year was about two hundred, of which about 15 per cent were users' samples and a considerable number were those submitted by Horticultural Commissioners. This shows a remarkable increase in the popular recognition and use of the laboratory by growers.

A new policy was also adopted this year of deputizing the County Horticultural Commissioners, thus securing their co-operation in the enforcement of the law. The following commissioners have been appointed for this work the present year:

County	Name	Address
Alameda	Fred Suelberger	418 14th st., Oakland.
Butte	Earl Mills	Oroville.
Colusa	L. R. Boedefeld	Colusa.
Eldorado	J. E. Hassler	Placerville.
Fresno	F. C. Schell	Fresno.
Glenn	Carl J. Ley	Willows.
Humboldt	G. B. Weatherby	Eureka.
Imperial	F. W. Waite	El Centro.
Kern	K. S. Knowlton	Bakersfield.
Kings	B. V. Sharp	Hanford.
Lake	G. A. Lyon	Lakeport.
Los Angeles	Wm. Wood	Hall of Records, Los Angeles.
Madera	George Marchbank	Madera.
Merced	N. H. Wilson	Merced.
Monterey	J. B. Hickman	Aromas.
Napa	A. D. Butler	Napa.
Nevada	D. T. Norton	Grass Valley.
Orange	Roy K. Bishop	Court House, Santa Ana.
Placer	H. H. Bowman	Bowman.
Riverside	R. P. Cundiff	Riverside.
Sacramento	F. R. M. Bloomer	Sacramento.

County	Name	Address
San Benito	L. H. Day	Hollister.
San Bernardino	S. A. Pease	Court, House San Bernardino.
San Diego	H. H. Weinland	Court House, San Diego.
San Joaquin	W. Garden	Rm. 10, Court House, Stockton.
Santa Barbara	C. W. Beers	Box 441, Santa Barbara.
Santa Clara	E. L. Morris	Hall of Records, San Jose.
Shasta	George A. Lamiman	Redding.
Siskiyou	J. F. Wetzel	Yreka.
Solano	C. R. McBride	Vacaville.
Sonoma	A. R. Galloway	Santa Rosa.
Stanislaus	A. L. Rutherford	Modesto.
Sutter	H. P. Stabler	Yuba City.
Tehama	Chas. B. Weeks	Red Bluff.
Ventura	R. S. Vaile	Santa Paula.
Yolo	G. H. Hecke	Woodland.

FARM MECHANICS

BY

F. L. PETERSON

The large number of students enrolled in the courses in Farm Mechanics demanded the entire attention of the staff.

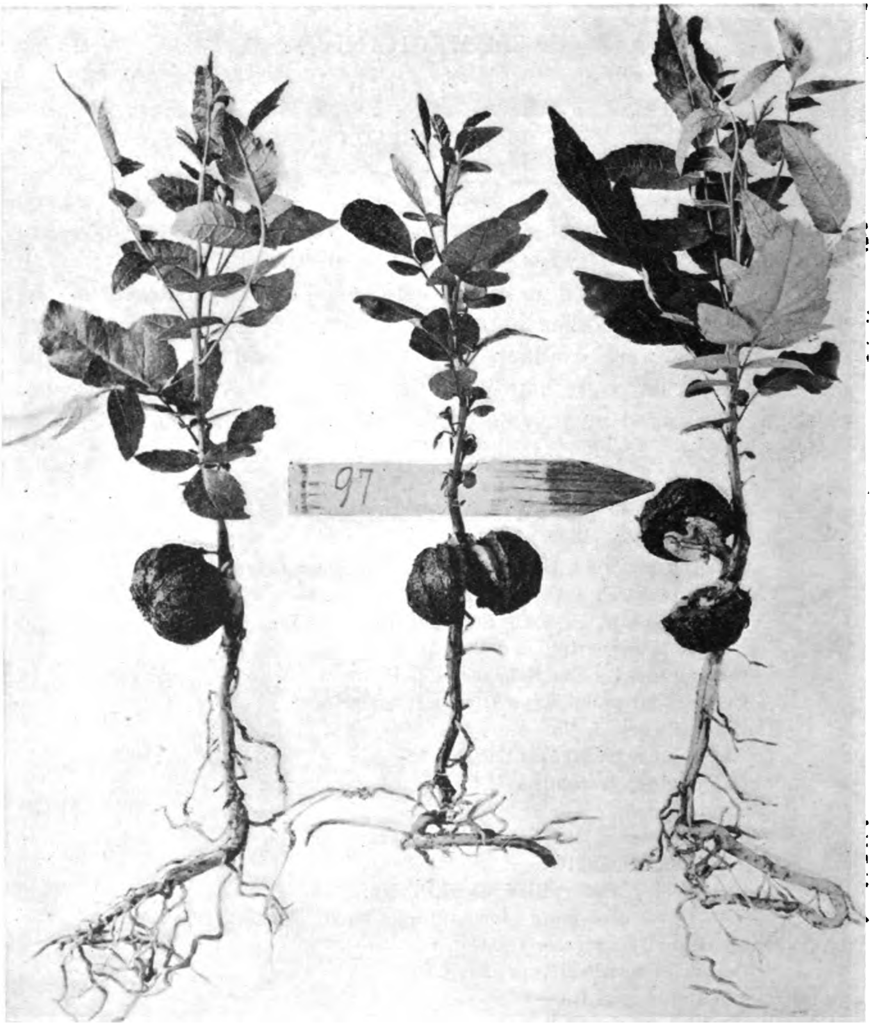
The division assisted in two traction engine demonstrations, one at Fresno and the other at West Sacramento, California. These demonstrations were conducted by "Orchard and Farm," but the technical questions were handled by this division. While this demonstration was staged by private enterprise, this division lent its assistance willingly.

LOANS TO THE DIVISION

Baker & Hamilton—
  Mowing machine, Buckeye, 5-foot cut, gear drive.
  Sulky plow, P. & O., Success, 14-inch share.
  Walking plow, P. & O., Scotch Clipper, 14-in.
California Engineering and Supply Co.—
  Gas engine, Ziegler Schryer, 4 H.P.
  Centrifugal pump, type B with hand primer.
Fairbanks Morse & Co.—
  Gas engine, horizontal, 10 H.P.
  Gas engine, vertical, 4 H.P.
  Stroke pump.
  Electric motor, 10 H.P. and starter.
Holt Manufacturing Co.—
  Gas tractor, Caterpillar, 65 H.P., No. 2074.
  Two Davis disc gang plows, 6 discs each, No. 294, 295.
International Harvester Co.—
  Gas tractor, wheel type, 25 H.P.
Pacific Implement Co.—
  Walking plow, 12-in., South Bend.
  Walking plow, 12-in., South Bend, black land.
  Walking plow, 10-in., South Bend, vineyard.

DONATIONS

John Deere Plow Co.—
  Gas engine, 2 H.P., Root & Vandervoort.
  Sulky plow, 12-in., Stag.
  Alfalfa cultivator.
  Manure spreader.



The new oak-like walnut in center; on either side a typical California black walnut seedling; all from *same cluster* of normal nuts from a California black walnut tree. Apparently oak does not enter into the origin of this new form.

GENETICS

BY

E. B. BABCOCK

Instruction.—The primary purpose in organizing this division was to provide instruction in the principles of breeding for sophomores in the College of Agriculture. Conforming to this plan, the writer's first attention has been given to the course for sophomores, with the result that a certain measure of success has been achieved.

During the past year eleven advanced undergraduate and three graduate students have worked on special topics in genetics and submitted reports or theses. The following topics among others have been studied: "Corn, Its Culture and Improvement," "Carnation Breeding," "Wheat Breeding in America," "Seed Selection and Breeding," "Pollen Germination in the Walnut," "Chromosome Counts for Certain Walnuts."

Research.—The policy of this division is to have comparatively few *projects* and numerous minor investigations going forward.

Study of a New Variety of California Black Walnut.—Since 1907 the investigation of a new form *Juglans californica* Watson has been under way for the purpose of discovering the nature and origin of this form. The variety has been described and various hypotheses concerning its origin discussed in University of California Publications in Agricultural Sciences, Vol. 2, No. 1. Recent work on this problem has led to the following conclusions:

1. The belief, which has been generally held, that the new form *J. californica* var. *quercina* originated through hybridization between walnut and oak is not supported by our observations and results.

2. There is no evidence that hybridization with other species of walnut or cross pollination with other trees of the same species causes the appearance of the new form.

3. Abnormal, late appearing flowers and fruits occur rather frequently on the wild black walnuts, but they very seldom produce *quercina* seedlings and certainly are not the cause of the origin of the new variety.

4. The evidence that seedlings of the new variety do come from certain normal nuts is conclusive since a tree has been located that

annually produces such seedlings among its normal progeny. What internal change or changes take place in the growth of the flowers or development of the young fruits that determine the appearance of *quercina* instead of *californica* seedlings remains to be discovered. This must be attempted by the further testing of individual nuts from the above mentioned tree and the microscopical examination of flowers in all stages.

Peach Breeding.—This report has to do with one phase of a threefold project, viz., the securing of improved fruits through cross breeding. Being impressed with the vigor, productivity and certain valuable fruit characters of the Chinese Saucer or Peen-to peach in Southern California, Mr. C. O. Smith and the writer made crosses in 1909 and 1910 between that species of Amygdalus and the following varieties of common peach: Strawberry, Frances, Florida Gem, Hall's Yellow, Sugar, Elberta, Rogers, Red Ceylon, Honey, Wheatland Cling, Japan Dwarf Blood, Carpenter. The original hybrid seedlings are on the grounds of the Whittier Plant Disease Laboratory. Buds from them are growing at Berkeley, where we also have second generation seedlings from the following crosses: Peen-to by Hall's Yellow and Elberta by Peen-to. These will be tested at Berkeley and, if promising, eventually at various other localities.

Through the courtesy of the Bureau of Plant Industry of the U. S. Department of Agriculture, the following new introductions have been received from the Chico Plant Introduction Gardens and are growing at Berkeley:

No. 353.	Mexican Peach (1)	S. P. I. 32380
No. 354.	Bolivian Freestone Peach (2)	S. P. I. 36127
No. 356.	Sutter Creek Peach (2)	S. P. I. 36125
No. 357.	Crosby Nectarine (2)	S. P. I. 34688
No. 358.	Freitcheng Peach (2)	S. P. I. 21989
No. 359.	Prunus davidiana (50)	S. P. I. 34515
No. 364.	Maxwell Nectarine (2)	S. P. I. 34684

From Arnold Arboretum bud wood of *Prunus mira* has been received and propagated.

Potato Improvement.—The collection of varieties under test in 1913 and the bulk of selected stock on hand was transferred to the Division of Vegetable Gardening at the University Farm in March, 1914. There were retained at Berkeley certain tuber-unit selections made in 1913 for the purpose of studying correlation between tuber characters, especially yield, and other vegetative characters, particularly height of plant and color and texture of leaves.

Tomato Hybrids.—Second generation plants have been grown from certain crosses made in 1911. The results generally agree with those secured by Gilbert at Cornell University. Certain of the F2 plants were selected for testing in F3 and the seedlings are now in the field.

Maize Hybrids.—A number of varieties including all the principal types of maize were grown on the campus in 1913. Many crosses were made and some of these will be grown for the study of inheritance.

Hybrid Lilies.—These are the only bulbous plants worked with thus far that give much promise of success. Some second generation plants are developing and the seed from last summer's crosses is sown.

Hunnemannia (Mexican Poppy).—Selection for tendency to produce double flowers was begun in 1913, and crosses were made between certain promising plants.

Vetches.—Several species of known value as cover crops are being grown for the purpose of producing hybrids in order to secure a form of greater value than any now under cultivation.

Flax.—A number of distinct species are being grown as material for the study of the physiological aspects of inheritance.

IRRIGATION INVESTIGATIONS

BY

FRANK ADAMS*

The work of this division has continued under the co-operative arrangement with the Office of Experiment Stations of the United States Department of Agriculture. Since 1903 the Office of Experiment Stations has maintained co-operative relations in irrigation investigations with the State Board of Examiners or with the State Department of Engineering, and throughout this period it has maintained its California office with this department at Berkeley. Since the establishment of the University Farm in 1907, a portion of the co-operative work carried on by the Office of Experiment Stations and the state boards has been carried on there, the University furnishing the land and labor and seed needed in the experiments and investigations and taking in return the produce raised. Since 1912 this division has been bearing approximately one-half of the total expense incurred in this irrigation work and has also paid sufficient of the salary of the irrigation engineer locally in charge at Davis to cover the time devoted by him to irrigation instruction there. During the past fiscal year this division has also contributed to the expense of duty of water investigations conducted by the Office of Experiment Stations and the State Department of Engineering in Sacramento Valley away from Davis and in Imperial Valley. Thus the irrigation investigations and experiments and the irrigation instruction at the University Farm to which this division has given support form an integral part of the co-operative irrigation work of the Office of Experiment Stations and the State Department of Engineering. The work reported by this division therefore includes a part of the work carried on under the joint auspices of the Office of Experiment Stations and the State Department of Engineering, our co-operative arrangement with the Office of Experiment Stations making it desirable that the California representative of that office shall also be the representative of this division in this work.

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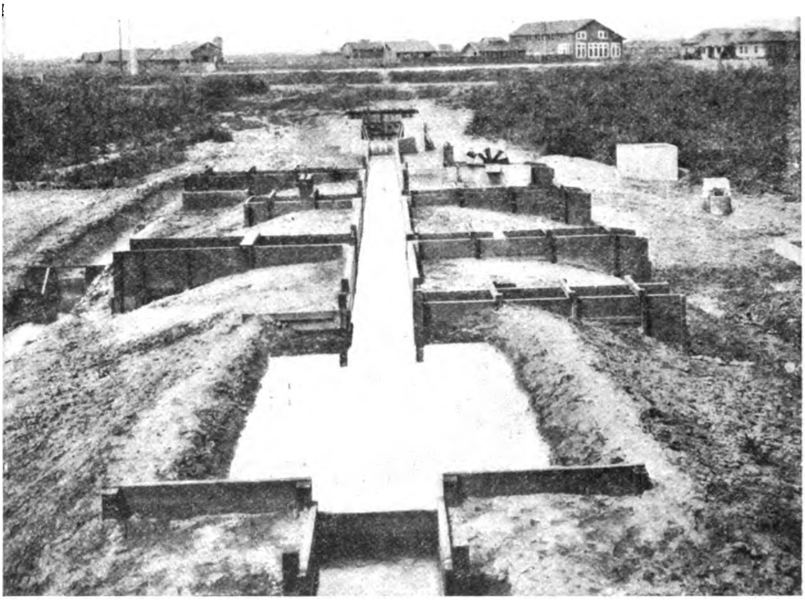
Irrigation Investigations at Davis.—As during several previous years, these have embraced the following lines of work: Duty of water investigations in connection with rotation experiments with wheat, oats, barley, Indian and Egyptian corn, sugar beets, potatoes, and alfalfa; methods of applying water to these crops; tank experiments for determining the water requirements of crops; irrigation of rice; the care and development of a small irrigated orchard and a small irrigated vineyard; and the installation and testing of irrigation measuring devices.

Two crops per season with irrigation. After harvesting a crop of grain on this land in May, 1913, the land was irrigated and seeded to Indian corn. In August and September eight to fifteen tons of green ensilage per acre were taken off, depending on the amount of water applied.

It is, of course, not possible in a single year to obtain conclusive duty of water data. Results up to and including the season of 1912 have been published in the United States Department of Agriculture Bulletin 10. Figures obtained in the experiments in 1913 continue to show that up to a certain point crop yields increase quite consistently with increasing amounts of irrigation water, after which in some cases they decrease. For instance, in one of the experiments with wheat the yield increased from 2.17 bushels with no irrigation to 30 bushels with 10 acre-inches of irrigation water per acre, decreasing then to 20.6 bushels with 15 acre-inches of water. This is a condition that has frequently been paralleled in other experiments, showing that farmers should give more and more attention to careful and economical irrigation. Just how carefully it is desirable to use water is also being indicated by the numerous soil-moisture determinations that are being made before and after irrigations. These determinations show that a large part of the water applied even under what are generally considered good methods of practice percolates below the zone of observation, which except with alfalfa, is usually the chief zone of root growth. In one field under observation, on which excessive quantities of water were applied by the owner of the tract, soil moisture determinations indicated that one-third of the water applied would have given equally profitable returns. The excessive use of water on this tract was primarily due to faulty methods of application, which the experiments at Davis are helping to correct. In all, 3900 soil moisture determinations for the irrigation plat on the University Farm were made in 1913 and about an equal number are being made in 1914.



Field laboratory of standard water measuring devices at the University Farm. It is intended for testing of these devices, for demonstration, and for use by students in irrigation at Davis. All of the standard devices in general use in California for measuring deliveries of irrigation water as well as several other kinds are included in the installation.

The work with measuring devices at Davis has been to complete an installation of standard devices for measuring the delivery of water to irrigators. In addition to a reservoir holding about one-quarter acre-foot, the installation, which is known as the Davis field laboratory of irrigation measuring devices, includes a standardizing box through which all of the water delivered to the measuring device is actually measured according to standard methods, a small concrete-lined canal, a short underground pipe system, and thirteen measuring devices for water delivery (p. 126). After this laboratory was completed to the present point, a series of careful tests was made of each of the devices in order to determine their relative accuracy. Since the installation of these devices, several individuals or companies who have developed special devices have made arrangements to install them in the laboratory at their own expense, and the same privilege will be granted to others. Thus it is expected ultimately to have installed on the University Farm examples of all of the more important irrigation measuring devices common to western field practice. An illustrated bulletin describing the devices installed in this laboratory and giving the results of the tests that have been made of them is now in course of publication by this department.

Complete cost data have always been kept in connection with the field irrigation experiments conducted on the irrigation plat. In 1913 the total cost for labor, cultivation, seed, irrigation, and harvesting was $392.01 and the total value, at current market rates, of the produce grown was $599.17, leaving a net profit for the farming operations of $207.16.

General Field Investigations.—Not counting investigations wholly paid for by the Office of Experiment Stations and the State Engineering Department, these have included studies of the duty of water for alfalfa on about fifty farms in 1913 and on forty-six farms in 1914; a study of duty of water for alfalfa on seven farms in Imperial Valley; and a study of irrigation, soil, and general crop conditions in the Sierra foothill belt. A bulletin giving the results of the study and outlining conditions in this important region is about ready for publication.

LANDSCAPE GARDENING AND FLORICULTURE

BY

J. W. GREGG

During the period of ten months just passed, the work of perfecting the organization and collecting materials and equipment for present as well as future instructional work has continued. As a result, the division is especially well prepared to greatly strengthen its various courses during the next collegiate year and in addition has been able to offer a number of new courses. In addition to the regular instructional work, much time has been spent, especially by Professor Stevens, assisted by Miss Jones, in collecting and tabulating valuable data concerning "plant materials," their nomenclature, value, and adaptability for use in landscape design in the varying soil and climatic conditions of California. Such data will prove of inestimable value for future instructional work and will, in addition, form the basis for bulletins and circulars as fast as the data may be completed.

Besides correspondence, a large amount of time has been spent in furnishing information in the form of reports, plans, specifications, and planting lists. Calls for such service have come from city and country schools, owners of small suburban and country homes, and cities and towns having park and playground problems to solve. Such problems, as far as practicable, have been handled by students majoring with this division, but under the direct supervision of members of the staff. Such service has been rendered only when it was perfectly clear that the work would not be in competition with the profession, and would, on the other hand, not be commercialized.

Requests for landscape advice in the form of plans for the development of rural school grounds, town parks, and playgrounds, have been so numerous that many have had to be refused or postponed until next year on account of lack of time to properly furnish such data.

During the year the division has been called upon by the University for assistance in carrying out the plans for foresting the hill-country east of the campus, and in view of the fact that Professor Stevens was closely associated with that work before coming to the

College of Agriculture, he has continued in such advisory capacity and has given a considerable amount of his time and thought to these planting problems, with the result that a most excellent season's work has been accomplished.

Planting plans for the Hearst Mining Building have also been prepared by this division, have been accepted by the President of the University, and the practical work of carrying them out is nearly completed. The above mentioned work claimed a considerable amount of Professor Stevens' time, both in study and supervision. As a result of this service already rendered the University the division has been instructed to prepare planting plans for the Doe Library, California Hall, Boalt Hall, and Agriculture Hall.

The landscape work in both permanent and temporary form has been continued this spring at the University Farm School at Davis, according to plans prepared during the winter; such plans calling for the use of about two carloads of stock, some of which has been purchased and some has come from the nurseries here at the University. The planting has progressed most satisfactorily with the result that Dormitories No. 1 and No. 2, both front and rear, and the Office Building, have been planted with permanent stock, and, in addition, plantings have been made around other buildings and groups of trees and shrubs located to produce future shade and a frame for the main portion of the campus. This work has also taken a considerable amount of time both here in the draughting-room and at Davis in consultation and supervision. This division has also furnished stock and labor for such planting at Davis to the amount of nearly $400.00.

NUTRITION

BY

M. E. JAFFA

The Nutrition Division has co-operated with the Animal Industry Division at Davis to the extent of carrying out chemical analyses of 80 samples of feeds. These comprised alfalfa, beet pulp, corn and oat silage, alfalfa and grain hays, and a number of grains, oil cake meals and dried beet pulps, as per accompanying tabulations. The samples were taken in connection with experiments conducted at Gilroy, Dos Palos, Davis, San Leandro, California, and Lovelock, Nevada.

Thirteen samples of chick feeds have been analyzed in co-operation with the Poultry Division at Davis.

The Nutrition Division has had charge of the chemical work involved in the inspection and control of certified milk by the San Francisco County and Alameda County Medical Milk commissions. This work involved chemical analyses of 279 samples of milk, cream and skim milk, taken by members of the Division of Veterinary Science. On the whole, the dairies supplying milk made a satisfactory showing, only one dairy being unable to reach the required standard. The certification for this dairy was withdrawn in July, 1913. Certified milk must contain not less than 3.5 per cent fat and a minimum of 8.5 per cent of solids not fat.

In reply to requests sent in by various companies and citizens of the state and in co-operation with the California State Dairy Bureau, a number of chemical examinations have been made. These include:

Milk	63 samples
Cream	12 samples
Butter	12 samples
Cheese	2 samples
Human milk	8 samples
Goat's milk	7 samples
Water	16 samples
Poultry and stock feeds	38 samples
Dates	1 sample
Avocado	1 sample
Spineless cactus	1 sample

Olive oil	1 sample
Flour	32 samples
Grape juice	1 sample
Gluten bread	6 samples

Also several toxicological examinations have been made of milk, breakfast food, sorghum, poultry and hog.

A Study of the Methods for the Determining of Sulphur Dioxide in Dried Fruits.—The experimental work of this project involved an investigation of the following points:

1. Precautions against extraneous sulphur.
2. Amount of sample to be used.
3. Amount of distillate.
4. Number of distillations necessary.
5. Number of absorption jars.
6. Nature of the oxidizer.
7. Quality of the carbon dioxide.
8. Amounts of other reagents.

A review of the literature on the subject shows several methods, most of which agree upon but one point—distillation. Many combinations of amounts of fruit, reagents and methods of operation are found.

Leach (Food Inspection and Analysis, 1st edition, pages 675–676) outlines a method for sulphur dioxide determination. He states that it is not necessary to use an absorber or an oxidizer for the sulphur dioxide, and suggests water as a means of receiving the distillate.

U. S. Department of Agriculture, Bureau of Chemistry, Bulletin No. 107, gives only the method for wine, which is outlined briefly as follows:

"Distill a 100. gms. in a current of carbon dioxide after the addition of about 5 cc. 20 per cent Glacial Phosphoric acid until about 50 cc. have passed over. Collect the distillate in a N/10 iodin solution.—Twenty-five cc. of N/10 iodin solution may be employed, diluted with water to give desired volume.—Determine the excess iodin with standard Hypo."

U. S. Department of Agriculture, Bureau of Chemistry, Bulletin No. 137, page 115, gives the following method:

"Distill from 20 to 100 gms. of the sample in a current of carbon dioxide after the addition of about 5 cc. of a 20 per cent solution of Glacial Phosphoric until 150 cc. have passed over. Collect the distillate in about a 100 cc. of nearly saturated bromine water. Allow the end of the condenser to dip below the surface of the liquid in the receiver.—When the distillate is finished, boil off the excess of bromine, dilute the solution to 250 cc., add 5 cc. hydrochloric acid (1–3), heat to boiling and precipitate with a 10 per cent solution of barium chloride. Boil for a few minutes, allow to stand over night in a warm place, filter on weighed Gooch crucible, wash with hot water, ignite at a dull red heat and weigh as barium sulphate.''

In starting this work on a method for the determination of sulphur dioxide in dried fruits several problems were faced. The chemical literature on the subject is very inadequate, and none of it gives information sufficient in detail to enable the analyst to obtain correct and duplicate results.

1. *Precautions Against Extraneous Sulphur.*—Numerous attempts to get blank determinations with reagents brought out the following facts:

(*a*) Some samples of potassium bromide contain appreciable amounts of sulfates.

(*b*) Rubber stoppers and tubing must be entirely eliminated from joints where steam, iodine, or bromide pass because the rubber liberates sulfur under these conditions.

(*c*) Sealed glass joints are best and should be used whenever possible. Other joints were satisfactorily made with rolled corks boiled in 20 per cent phosphoric acid solution.

(*d*) Distillates must not be exposed to atmosphere charged with products of gas combustion. Electric heaters, therefore, were used in a hood for evaporations. Distillations were made with gas because the distillates were protected from atmospheric admixture.

(*e*) Attention to the above points permitted us to obtain perfect blank determinations.

2. *Amount of Sample to be Used.*—Should be governed by amount of sulphur dioxide present to the extent at least of being able to obtain satisfactory titrations or precipitates of convenient size.

(*a*) Experimental Data on Peaches and Apricots.—100 gms. fruit were found to cause too much foaming unless inconvenietly large distillation flasks were used. 50 gms. showed same trouble. 16 gms. showed same trouble, but could be used in 1 liter distilling flask if necessary. 8 gms. found to give quite satisfactory results in a 500 cc. distilling flask without the use of a foam preventor. Apricots seem to foam more than other fruits used in following experiments. Since 8 gms. does not give inconveniently large titrations or precipitates, this weight was adopted. This agrees with the unpublished experience of other investigators.

3. *Amount of Distillate.*—Successive distillations were made from same sample by adding water to residue as follows:

(*a*) Experiments with Iodin and Apricots.—8 gm. sample of apricots and 20 cc. 20 per cent phosphoric acid solution and 180 cc. of water in 500 cc. Jena distilling flask with current of carbon dioxide from Kipp generator. Carbon dioxide contained no sulphur, as shown by lead acetate solution in wash bottle interposed between generator and distilling flask. Flask carried cork stopper. Two Drechsel gas absorbers connected by rubber tube—there being not more than three-quarters inch of rubber exposed to action of iodine. For the first distillation the first absorber contained 50 cc. N/100 iodine in potassium iodide, and the second contained 25 cc.; for succeeding distillations 25 cc. N/100 iodine was placed in each absorber.

EXPERIMENTS CARRIED OUT IN DUPLICATES MARKED A AND B

No. of Distillates	Apparatus	Vol. of Distillate	Cc. I. absorbed		mg. SO_2 per kilo.	
			1st abs.	2nd abs.	1st abs.	2nd abs.
1st	A	175	13.2	1.02	528	40.8
	B	175	13.1	1.20	524	44.0
2nd	A	150	4.0	.70	160	28.0
	B	150	6.1	1.50	244	60.0
3rd	A	150	5.0	Not appreciable	200	......
	B	150	6.8		272	......
4th	A	150	3.6	Not appreciable	144	......
	B	150	5.2		208	......
5th	A	150	3.5	Not appreciable	140	......
	B	150	6.7		268	......
6th	A	150	2.6	Not appreciable	104	......
	B	150	4.9		196	......
7th	A	150	2.5	......	100	......
	B	......	Flask broke		......	......
8th	A	150	3.4	......	136	......

These results show one or two things or both, viz.:

(1) A distillate neutral to iodine is not obtained on account of volatile organic matter, or else reduction of sulfate to sulfite in distilling flask.

(2) Iodine is volatilized from absorbers by the current of carbon dioxide. This would be disastrous to volumetric determinations without additional inconvenient absorbers, but of no importance to a gravimetric determination of sulphur.

This is but one of several experiments with similar results.

(*b*) Experiments with Bromine and Apricots.—The distillations with bromine were made primarily to determine the amounts of sulphur dioxide obtained from successive distillations on the same sample and also the relative amounts obtained in the 1st and 2nd absorbers. For the first distillation—the 1st absorber contained 100 cc. bromine in potassium bromide and 10 cc. sodium carbonate; the 2nd absorber 25 cc. bromine and 3 cc. sodium carbonate. For each successive distillation 50 cc. bromine and 5 cc. sodium carbonate and 25 cc. bromine and 3 cc. sodium carbonate in the 1st and 2nd absorbers respectively. 175 cc. distilled over the first time and 150 cc. for each succeeding distillation. Six distillations were made. The experiments were made in duplicate as indicated below:

A	1st Distillation		2nd Distillation	
	1st absorber	2nd absorber	1st absorber	2nd absorber
A	411	41	54	205
B	417	trace	trace	trace

In distillations 3, 4, 5, and 6, the precipitates were so small as to be negligible—also from all but the 1st absorber in apparatus B. It will be noted in the 2nd distillation, apparatus A, that the parts per million are about four times greater in absorber 2 than in absorber 1. Probably this was due to the action of the bromine on the rubber connection, brought in by hot water washings. It was therefore decided to make a glass seal between the absorbers.

B	1st Distillation		2nd Distillation		3rd Distillation	
	1st absorber	2nd absorber	1st absorber	2nd absorber	1st absorber	2nd absorber
A	527	27	154	89	99	78
B	626	44	345	78	89	119

The above results were probably influenced somewhat by a fall of soot in the evaporating hood.

Another experiment was therefore made on part of the same sample, which showed more nearly comparable results.

C	1st Distillation		2nd Distillation	
	1st absorber	2nd absorber	1st absorber	2nd absorber
A	530	none	78	none
B	534	none	154	none

The discrepancy between the second distillation in A and B is here probably due to failure to stop the first distillation at the same degree of dryness.

Too moist residues may retain sulphur dioxid and too dry ones may make sulphur dioxid from the interaction of sulphuric acid and organic matter at a high temperature.

Another set of several distillations were made, which showed very concordant results, but the data were unfortunately lost. Owing to the pressure of fruit processing to which these experiments were preliminary, there has yet been no opportunity for duplicating that data. It will be undertaken within the next week or so after the sulphur squad has disbanded.

The Bromine Method Applied to Syrup.—Several determinations of sulphur dioxide in Karo corn syrup were made where the sulphur dioxide content of the syrup was very high. Using an 8 gm. sample, it was found that even with boiling to a very small volume, it was impossible to get all the sulphur dioxide. However, when an 8 gm. sample was diluted to 100 gms. and a 12.5 gm. sample of this dilution used, a single distillation of 175 cc. carried over all the sulphur dioxide as shown by the folowing results:

	Sulphide dioxide
8 gm. sample of syrup undiluted	13165 parts per million
8 gm. sample of syrup diluted, 12.5 gms.	17727 parts per million

Second distillations showed several hundred parts in the 8 gm. undiluted sample, while the diluted 12.5 gm. sample showed only a trace.

Direct Oxidation Method.—The plan of this method was as follows: Fifty grams of finely chopped dried fruit placed in a mortar dampened with water and made alkaline with sodium carbonate, macerated to a smooth pulp. Transferred to a 500 cc. graduated flask and made nearly to volume. Allowed to stand over night. Added acid to mark the precipitate pectins, etc. Centrifuged and pipetted off to 100 cc. portions.

The first portion: heated to boiling, acidified with hydrochloric acid and precipitated with barium chloride, allowed to stand, filtered washed and ignited.

The second portion: added bromine to oxidize sulphur dioxide to sulphuric acid, added 5 cc. concentrated hydrochloric acid, boiled off the bromine, allowed to stand, filtered, washed and ignited.

A considerable amount of barium salts other than the sulfate was here precipitated. This material was removed by the usual procedure of purifying the barium sulfate precipitate, viz: after the ignition, all the barium present in a form other than the sulfate will be soluble in hydrochloric acid and may be removed by digestion with dilute hydrochloric acid.

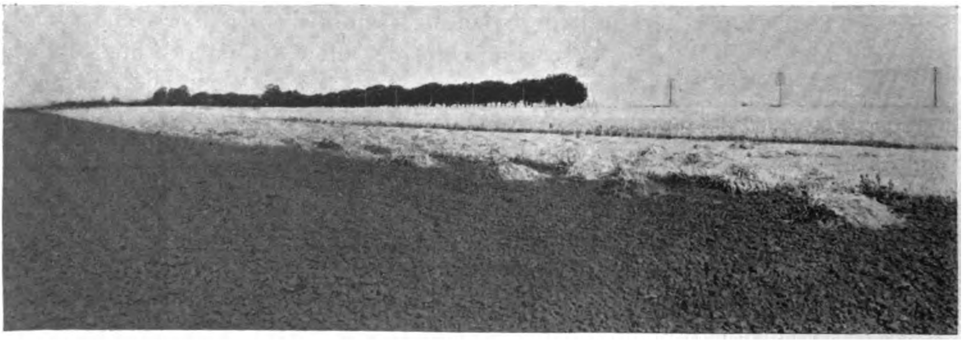
Filtration and ignition then gave a pure barium sulfate precipitate ready for weighing.

The difference between the two precipitates calculated to sulphur dioxide gave the sulphur dioxide present in the fruit.

However, serious difficulties were encountered which as yet we have not been able to meet. These consisted in the details of manipulating the large amounts of gelatinous material yielded by fruit juices upon acidifying. Alcoholic precipitation and centrifuging did not completely remove these difficulties, but they did not appear to be insurmountable if more time were given to this method.

Summary.—Sulphur dioxide determinations in fruits are now being made according to the following method:

1. Side neck 500 cc. distillation flask with a cork stopper.
2. Fruit finely macerated and thoroughly mixed.
3. 8 gm. sample placed in flask.
4. 20 cc. 20 per cent phosphoric acid added.
5. 175 cc. distilled water added to contents of flask.
6. 500 cc. Drechsel absorption jar connected to condenser with as short rubber connection as possible, inlets bent vertically for direct connection with vertical spiral condenser. 100 cc. solution of 20 gm. per litre potassium bromide, saturated with bromine and 10 cc. 10 per cent sodium carbonate solution used in jar for absorbing medium.
7. Sodium bicarbonate used in second 500 cc. Dreschel absorption jar to catch volatile bromine.
8. Current of pure carbon dioxide gas passed through the whole apparatus.
9. Distill with medium flame until about 180 cc. have passed over or until the fruit in the distilling flask is in pasty condition.



Extensive as well as intensive agriculture

10. Transfer distillate to 600 cc. Jena beaker, add 5 cc. concentrated hydrochloric acid, and evaporate to about 5 or 10 cc. on electric hot plate in clean hood.

11. Take up with hot water, transfer to 150 cc. beaker, heat to boiling.

12. Precipitate with few drops of barium chloride.

13. Leave in warm place over night, filter, wash with hot water, burn and weigh.

The method as given thus in detail gives very satisfactory results. Almost perfect blanks are obtainable at will and duplicate and concordant results are the rule, as indicated by the following results:

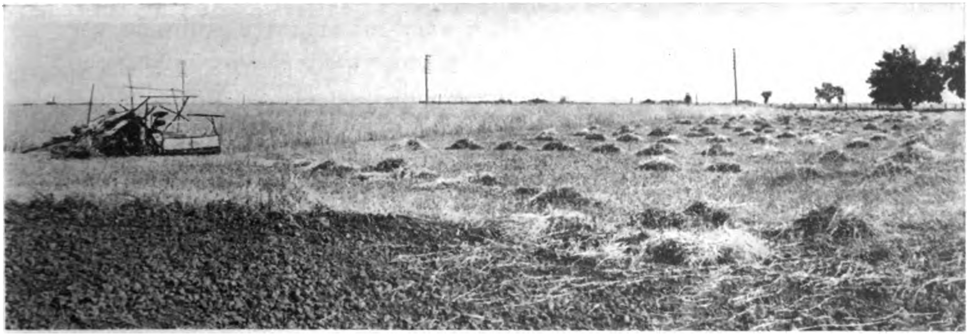
A	Sulphur dioxide Parts per million Original	 Duplicate
Prunes	924	931
Raisins	996	1,044
Nectarines	524	504

The results shown in the following table were obtained from specially prepared samples of processed fruits.

Samples of dried fruit were purchased on the market, which were as nearly uniform as possible. 100 gram portions were weighed into jars, 1 tablespoon of sugar and 200 cc. of water added. The jars were placed in an autoclave and cooked for forty minutes at about 5 lbs. pressure.

Removed and allowed to cool. A definite quantity of glucose-sulphurous acid (prepared by passing sulphur dioxide gas through Karo corn syrup) was weighed into each jar of each lot.

The figures here presented represent the results of separate determinations from individual jars.



is practiced at the University Farm.

		Sulphide Dioxide Parts per million	
		1st jar	2nd jar
Peaches	Lot 1	517	480
	Lot 2	3,353	3,370
Pears	Lot 1	377	462
	Lot 2	2,746	2,808
	Lot 3	9,576	9,555
	Lot 4	277	280
Apricots	Lot 1	4,270	4,342
	Lot 2	3,904	3,836
	Lot 3	2,421	2,407
	Lot 4	9,250	9,271
	Lot 5	359	393
Nectarines	Lot 1	1,767	1,804
	Lot 2	524	503
Prunes	Lot 1	2,770	2,781
	Lot 2	9,076	8,978

This, of course, is no critical check on the method, but illustrates its practical application to the work for which it was prepared. Results on two jars from one lot show no variations greater than may be neglected for the experimental dietetic purpose for which they are intended.

Resumé of Work of State Food and Drug Laboratory.—The data reported represents the period from July 1, 1913 to May 1, 1914. During this time twelve hundred and fifty-eight samples were submitted to the laboratory. Five hundred and twenty-one unofficial samples are included in the number just quoted. These consist in the main of samples submitted by the stewards of the different state institutions in accordance with instructions from the State Board of Control. The purpose of the State Board of Control in asking the co-operation of the laboratory in this matter is to ensure a high standard and quality of foods, drugs, and miscellaneous supplies for the several state institutions. It is of more than passing interest to note that since such inspection and examination has been carried on, there has been an appreciable and material improvement in the quality of the supplies furnished.

Complete reports of the work of the laboratory and full details with reference to the organization charged with the enforcement of the food and drug law, the duties of inspectors, the matter of hearings, etc., is published in the biennial report of the State Board of Health.

PLANT PATHOLOGY

BY

RALPH E. SMITH

"Physiological" Plant Diseases.—The most technical fundamental project of investigation is a systematic study or review of the important "physiological" plant diseases. There has always been in Plant Pathology a sort of "catch-all" for diseases of which the cause was not known and which seemed different in nature from those attributable to thoroughly understood agencies. Twenty-five years ago for instance, fungous diseases were only just getting to be thoroughly understood, and this term was not a specific one. Ten or fifteen years later the knowledge of fungi had advanced sufficiently to make it possible to detect and identify most parasites of this class, while the knowledge of bacterial plant diseases was just coming to the fore. A tendency developed, therefore, to attribute all diseases of unknown cause to bacteria, and bacterial diseases meant at that time almost anything in which the real cause had not been demonstrated. The same definition applies now to the term "physiological" disease, although it should be said that there appears to be a class of specific diseases in which neither bacteria nor fungi are the causal agents. It is undoubtedly true, however, that in the case of some of these troubles, organisms of these groups may yet be detected. Others may represent purely functional or nutritional disturbances, while in still other cases the troubles appear to be infectious and it is therefore to be presumed that some obscure form of parasitism exists. Considerable work has been carried on during the past year upon several of these diseases, particularly the internal brown streak of the potato; the little leaf of the cherry and other trees, exanthema or die back of the olive and other trees, and curly top of the sugar beet. On the potato disease Mr. S. S. Rogers carried on a large field experiment, endeavoring to determine the relation of such factors as time of planting, amount of soil moisture, fertilizers, and time of harvesting to this disease. Nothing of an affirmative nature was learned as to the nature of the disease, but the incorrectness of several previous theories was shown, particularly that of the idea that the disease is caused by a deficiency of soil moisture or potash. Variations in these elements showed no relation to the disease in Mr. Rogers' experiment.

The so-called little leaf is a very serious trouble affecting all sorts of trees in the San Joaquin Valley. It has been present there for several years, always showing a more or less definite relation to soil moisture conditions. The disease seems to develop along with a hard, dry subsoil, especially if soil moisture is particularly lacking late in the season. On the other hand, it does not appear that this soil condition alone can cause the specific disease. Various theories have been proposed as to the connection of crown gall, nematode root knot and other agencies with this trouble, but none of these has been definitely established. Our work during the past season has cast a very great doubt upon the connection of any of these things with little leaf. With the help of Professor Lipman this division has also shown that the disease is not due to alkali. Much of the work has been of a fundamental nature on the condition of the diseased tissues.

Exanthema of the olive is a disease which has begun to attract considerable attention and alarm. The effect of the disease is a dying back, falling off in production and final death of the trees. This disease appears to be identical with the exanthema or Florida die back of citrus trees and should be studied with the latter in mind. This division is co-operating to some extent with Professor Lipman. since he has already been studying some soil phases in connection with the citrus trouble. In this division a considerable amount of interesting work has been done during the year upon the anatomy and cytology of affected trees and the conditions which accompany the disease. Another case of apparently the same disease is that of a number of acacia trees on the University Farm at Davis. Here, under apparently quite different soil conditions from those in the citrus districts where exanthema occurs, an identically similar disease appears to occur. This case is also being studied in an endeavor to determine the actual cause of the disease, which should show a correlation in these various cases.

Curly Leaf of Sugar Beet.—This is a very serious and peculiar disease, the cause of which is entirely unknown up to the present time. One interesting fact has previously been demonstrated—namely, that the disease is spread by an infection carried in the sting of a minute insect, *Eutettix tenella.* This fact gives the disease particular interest, since a knowledge of the exact nature of the infection which this insect transmits might aid greatly in the understanding of other plant diseases. From the results of studies now going on there is reason to suspect that this is a parasitic trouble of a somewhat peculiar nature.

Olive Knot.—Work on the control of this disease has been continued during the past year, and the investigation is now practically completed. Professor Horne and his students have succeeded in showing very clearly the nature and mode of development of this trouble and the means by which it can be practically arrested.

Armillaria mellea.—The trouble which is caused by this toadstool fungus spreading underground and attacking the roots of many different kinds of trees is becoming an increasingly serious problem in California. In a great many orchards there are gradually enlarging areas here and there where this parasite is taking out the trees. This problem has been pursued during the year by studying the exact mode by which the fungus spreads from root to root, and by carrying on various experiments for stopping its spread by means of barriers and by treating the soil with carbon bisulphide.

Walnut Blight Control.—Spraying experiments made in 1913 for the control of walnut blight and an accompanying pest, walnut aphis, showed quite encouraging results, so that the work has been repeated on a larger scale during the early spring of 1914. More than fifty acres of large walnut trees were sprayed near Goleta in co-operation with the Bishop Ranch, while a considerable amount of spraying was done in other places more or less as a result of and in co-operation with our work. These efforts to develop practical means of spraying large trees have been notably successful, so that whereas it cost more than one dollar per tree to spray large walnut trees poorly in our work in 1906, it is now possible to spray such trees thoroughly at about one-half of this cost. The results of the spraying, using mainly lime-sulphur, have been decidedly good in regard to aphis and promise well for blight control. This work has been carried on with much energy and efficiency by Mr. Walter H. Nixon, who was temporarily employed for the purpose.

In addition to the spraying work, the chief of this division has given considerable attention to an effort to obtain desirable and more or less blight-free walnut varieties by selection among the very large number of seedling English walnut trees in this state. In this work many groves and trees have been visited and the occasional trees which seemed promising have been propagated by grafting into other trees in various places, so that these new varieties might be thoroughly tested. Scions of several varieties were also imported from Europe by the writer and these are now being tried out. The whole subject of walnut varieties is a very new one in the state, and the writer has kept closely in touch with every development along this line, having now under observation a number of selections which promise very well for the future. Another important phase of the walnut work is that of the extension of the industry into parts of the state where the crop is not commercially grown at present. Much interest in walnut culture exists in California at the present time and much of the writer's time is consumed in answering inquiries and investigating matters connected with the general development of walnut culture. By a conservative encouragement of the industry in regions where further development seems possible, especially where based upon new varieties or increased knowledge of old ones, the culture of the walnut may be profitably developed.

Among the numerous cases of plant diseases which are continually being brought to the attention of this division there is occasionally one which merits further investigation or which develops into a specific problem. Among those which have received more or less special attention during the year may be mentioned the following:

Bean Rust.—Mr. Rogers did a considerable amount of work during the year in an endeavor to find means for checking a serious rust (*Uromyces appendiculatus*) which attacks the Kentucky Wonder bean in San Diego County and prevents the growing of this valuable crop late in the fall. Treatment both with Bordeaux mixture and finely ground sulphur was tried, but unfortunately neither material gave any appreciable control of the disease.

Pear Canker.—A peculiar disease of the pear tree developed in El Dorado County during the past winter, consisting in the production of large, dead, canker-like spots upon the bark of the young trees. Much uncertainty prevailed at first as to the nature of this trouble, but we have found that it is quite certainly due to a fungus and one which can probably be controlled by spraying at the proper season.

Asparagus Diseases in Imperial County.—The disastrous experience which growers all over the country have had with asparagus rust during the past fifteen years has caused this disease to be greatly dreaded in every new district. Consequently when this crop showed a new trouble in Imperial Valley during the past fall, the growers became greatly alarmed, supposing it to be the much dreaded rust. Investigation, however, showed that it was not rust but a different fungus (*Cercospora asparagi*) which it is hoped will prove to be much less serious than the true rust. The matter is still under observation.

Wood Decay of Orchard Trees.—Almost all of this decay results from infection through unprotected wounds made in pruning or grafting or from breaking of limbs, sunburn and similar sources. Work will be continued to demonstrate more forcibly to the growers the amount of loss which is taking place through this source and the means by which it might be prevented. There is perhaps no disease in the state which causes so much actual loss in the production of trees per acre as this little thought of and entirely unheeded wood decay fungus.

POMOLOGY

BY

BURR B. PRATT

It is generally recognized that provision for cross-pollination is advisable for most deciduous fruits. Investigators working with plums in other states have ascribed a marked degree of self-sterility to many of the Japanese varieties. The Domestica or European plums, however, have been little studied and have been commonly considered in large part self-fertile. Growers in California have attributed a considerable proportion of the failure to set fruit with many varieties of Domesticas to this lack of self-fertility. This group comprises drying prunes and a large part of the shipping plums.

With a view to determining the actual relative importance of this factor in determining the set of Japanese and European plums, a project dealing with plum pollination has been started, the preliminary work of the first year being conducted in the orchards of the University Farm at Davis. This work involved studies on: (1) The percentage of fruit set on some of the leading varieties, where cross-pollination was prevented; (2) the percentage of fruit set under definite crosses; and (3) the percentage of normal set of the same varieties. In addition, data are at hand showing blooming dates for two seasons in this orchard.

The information gained by one season's work is altogether too meagre to warrant the drawing of conclusions. It may be said, however, that the results indicate that many of the popular conceptions regarding these factors in the state may be well founded.

The investigation will extend over a series of years and will be carried to commercial orchards in the leading districts.

The Student orchard project proposes the establishment of plantings showing the life-history of the leading deciduous fruits and nuts from seed to bearing age. The work is primarily designed for laboratory and demonstration purposes in connection with the University and Farm School courses, and will be largely carried out by students under the direction of the instructors in charge.

The plantings will be in rotation form, showing the effects of the leading rootstocks, methods of propagation, planting, heading, and pruning at varying ages. As the work progresses, a valuable collection of experimental data will be accumulated showing the effects of different methods of handling under the soil and climatic conditions prevailing at Davis.

The first unit of these orchard plantings has been made. The plantings include also leading small fruits as well as nursery material to be used in future plantings.

California has a practical monopoly on the production of the almond. Little definite information of a thoroughly reliable character with regard to the proper handling of this fruit is available. With a view to supplying this information studies in almond culture are under way. Nursery stock is growing which will provide material for an experimental planting designed to furnish data covering a wide range of cultural practice, including the value of different methods of pruning and cost of production.

Bartlett pear trees in University Farm orchard, Davis. Looking west down the row are apricots, then peaches, plums, and finally almonds at the far end. These trees are all in their sixth year, having been planted in March, 1908. The pears are standard trees, being on pear root.

Almond varieties will be given detailed attention with regard to their characters and commercial value. Records are on file giving important phenological data and type differences as indicated by the proportion of meats to whole nuts.

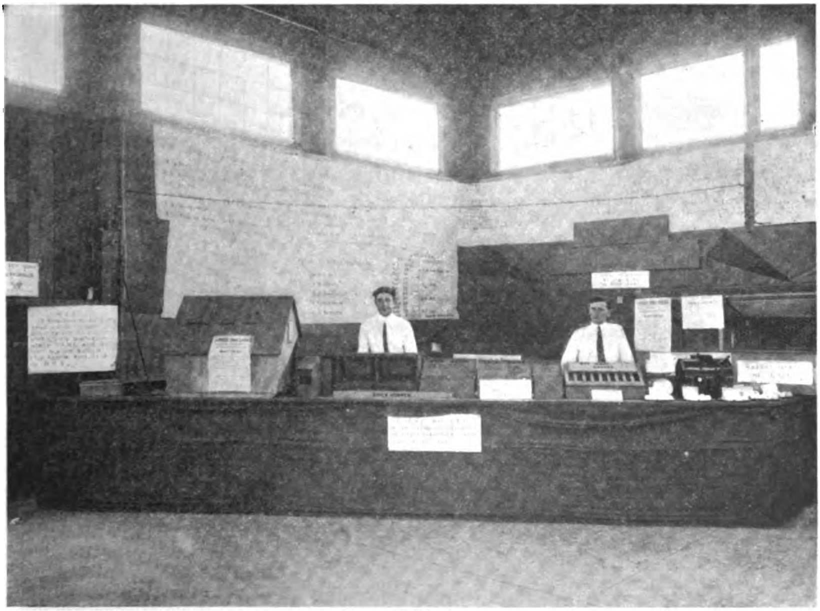
A study has also been made of the conditions and methods prevailing in leading almond districts.

POULTRY

BY

J. E. DOUGHERTY

Investigation.—A feeding experiment to find the relative values of soy bean meal, meatscrap, buttermilk and O. P. linseed oil meal as high protein feeds for laying hens and the minimum amounts of meat and vegetable proteins that can be fed for best results was started December 1, 1913, and will last one year. The feeding of high protein animal feeds represents one of the most important economic problems the poultryman has to deal with, for such feeds are not only the most expensive feeds required in a poultry ration but the cost of animal protein is steadily increasing. As a result the data of this experiment, showing the relative values of the above vegetable protein feeds as substitutes for a part of the more expensive meat feeds that may most



This educational exhibit was staged at all of the leading poultry shows of the State by the Poultry Division during the fall and winter of 1913–14 and proved a great success.

profitably be fed to fowls, will be of great value to the commercial poultryman.

Another experiment to find the relative effects of different degrees of temperature on the number and quality of chicks hatched in incubators and reared to four weeks of age is now under way.

Serious attention has been paid to the yarding, housing, and equipment best suited to poultry conditions in this state. More and more people are going into the poultry business on small acreage each year and they wish to utilize the land to the fullest and build just as inexpensive houses and equipment as possible which will give successful results. With these ends in view, we are attempting to find (*a*) the best methods of yarding and optimum amount of yard room per fowl under our climatic conditions, (*b*) the most suitable types of houses and equipment. Our aim is to design, prove out, and recommend such buildings and equipment as are low in first cost, simple to construct and easy to operate, yet give the very best results. A trapnest and mash hopper might be mentioned as two pieces of equipment designed by this division which have been eagerly taken up by poultrymen because of their many advantages.

An improved brooder system has been designed to meet a serious need for an intermediate sized brooder of simple construction that will operate successfully on low grade fuel oil. It will soon be tested out under commercial conditions.

Extension.—The division sent a member of the staff with an educational exhibit consisting of models of laying houses, brooders, trapnests, hoppers, etc., feed formulas, egg grading demonstration, bureau of information and a great deal of other material to the following fairs and poultry shows:

State Fair, Sacramento—September 13–20, 1913.
San Jose Poultry Show—October 15–18, 1913.
Willows Poultry Show—November 12–15, 1913.
Oakland Poultry Show—November 25–30, 1913.
Petaluma Poultry Show—December 10–13, 1913.
San Francisco Poultry Show—December 31–January 4, 1914.
Los Angeles Poultry Show—January 7–13, 1914.

This exhibit proved very popular wherever staged. A crowd of people could always be found around the booth from early morning till late at night seeking information.

GIFTS

One trapnest—Petaluma Incubator Company.
One mash hopper—Terrell Manufacturing Co., Montesano, Wash.
Trio of Buff Wyandottes—O. S. Hofman, San Jacinto, Cal.
One Houdan cockerel—Mrs. E. F. Reid, San Jose, Cal.
Two settings Silver Spangled Hamburg eggs—W. M. Ross, Glendale, Cal.
One setting Silver Wyandotte eggs—W. M. Ross, Glendale, Cal.
One setting Golden Campine eggs—N. C. Luce, Los Angeles, Cal.
Trio Partridge Wyandottes—C. J. Struby, Concord, Cal.

LOANS

One electric incubator—O. S. Hofman, San Jacinto, Cal.

SOIL CHEMISTRY AND BACTERIOLOGY

BY

CHARLES B. LIPMAN

Research Work.—In accordance with the desires of the Director, the major energies of this division are devoted to research work. It has been able to carry out investigations on every one of the twelve projects submitted for approval last summer. In addition to these, considerable work has been done on incidental problems with which the exigencies of research work inevitably confront the investigator.

The net results of these investigations, the details of which are given in our project reports (see pages 25 to 34), have been such as are invested with very great practical and scientific significance. Some of the investigations concerned have already been published or are about to appear in print in the following papers:

1. Antagonism between Anions as Affecting Soil Bacteria, II. Nitrification, published in Centralblatt für Bakteriologie.
2. The Effects of Copper, Zinc, Iron, and Lead Salts on Ammonification and Nitrification in Soils, published in the University of California Publications, Series in Agricultural Sciences.
3. Studies on Ammonification in Soils by Pure Cultures, published in the University of California Publications, Series in Agricultural Sciences.
4. Toxic Inorganic Salts and Acids as Affecting Plant Growth, published in the Botanical Gazette.

Material is also in preparation for the publication of several other papers dealing with the researches of the past year. These researches have made an important contribution to some of the fundamental problems which confront the soil fertility student and the student of agricultural plant physiology.

Routine Soil Examinations and Extension Correspondence.—Two thousand seven hundred and eighty-three (2783) samples of soil were examined during the year ending June 30, 1914, in the various ways necessary for giving information relative to alkali content and plant food content, as well as to the adaptability of soils for crops and as to methods of tillage and fertilization to be adopted.

Twenty-five hundred fifteen (2515) letters have been written by this division during the past twelve months, upward of 90 per cent of which have dealt with information for the use of farmers, growers, landowners, and prospective settlers. In some cases this information was given on the basis of samples submitted, in others on the basis of information already in our hands from past studies of the Federal Bureau of Soils and this Experiment Station.

Co-operation with Other Divisions.—The Division of Soil Chemistry and Bacteriology has co-operated and is still co-operating with the Division of Soil Technology to the extent of making alkali determinations on the soils of the quarter section of the Kearney Tract, which is being reclaimed by flooding and underdrainage. Six hundred and forty-two (642) samples of soil, taken prior to the flooding of the land, have been examined for all the alkali salts, and in July a similar number of samples from the same spots will be taken and analyzed in an attempt to ascertain how the alkali content of the soil has been affected by flooding and underdrainage.

This division has also co-operated with the Division of Viticulture to the extent of analyzing twelve (12) samples of soil for nitrogen, phosphoric acid, potash, and lime. These samples, six in each case, came respectively from the University Farm at Davis and from the Kearney Tract, where experimental vineyards are at the present time planted. The analyses were carried out for giving information which would serve as a basis, at least in part, of comprehensive fertilizer experiments to be undertaken by the Division of Viticulture.

SOIL TECHNOLOGY

BY

CHARLES F. SHAW

Soil Surveys.—The Division of Soil Technology, in co-operation with the U. S. Bureau of Soils, has carried on soil survey work in the state throughout the year. The soil survey of the Sacramento Valley was started on July 1, 1913, and completed in December. The report was prepared and, with the map, sent to Washington in March. In this survey, an area of about 4,500,000 acres was mapped and over one hundred individual types of soils were found. Some of them were so small in extent that they were not shown on the map, sixty-six types, in thirty-five series, being shown on the completed map.

During the months December to February, the division co-operated in the completion of the survey of Merced County, covering an area of about nine hundred square miles. In February, the soil survey of Southern California was begun, work continuing there until May 1, when the southern work was suspended and the field forces moved north.

Detailed surveys are under way in the Russian River Valley and in the Honey Lake area, and the reconnaissance survey of the bay region was started early in May. It is anticipated that each of these surveys will be completed within the ensuing fiscal year.

Drainage Investigations.—In co-operation with the Office of Experiment Stations of the U. S. Department of Agriculture, the division has drained a quarter section of land on the Kearney Ranch near Fresno. In this area of about 154 acres, 22,030 feet, or about 4.17 miles of tile have been laid. An electrically driven pump has been installed in the sump into which the tile drains and most of the area has been flooded to aid in the removal of alkali. The total cost to date is about $9000. The area that is being reclaimed was some years ago a profitable bearing vineyard, but through high water tables and accumulations of alkali it has been rendered worthless. On another area an experiment has been started to test the efficiency of reclamation by pumping water from a sump without tile drainage. If efficient, this latter method will be much more desirable than the former, as the cost per acre will be reduced to about one-fifth or less.

In co-operation with the Division of Irrigation Investigations of the Office of Experiment Stations, a study of the soils of the Sierra foothills was carried out. The report on this study is incorporated in a bulletin on the irrigation in the Sierra foothills.

During the year the division has co-operated with other divisions, the most important work being the study of the soils on the site offered for the Citrus Experiment Station. The division has also co-operated with the Selby Smelter Wastes Commission in conducting studies on the effect of smelter wastes on soils and crops. Some experiments are now under way to determine the effect of sulphur fumes on growing crops.

TOBACCO INVESTIGATIONS

BY

W. A. SETCHELL*

The experiments under grant of Adams' Fund called Project No. 21 have been proceeding as usual during the year 1913–14 in co-operation with the Department of Botany. Data have been accumulated and drawings and photographs have been made. The earlier results of work on this project have been published in volume V of the University of California Publications in Botany. Two papers are in active state of preparation at present, one under the immediate direction of Dr. Goodspeed, who has the assistance of Dr. R. E. Clausen; the other is being prepared by myself. Dr. Goodspeed's report will concern itself with the floral complex, and is an attempt to analyze the various factors entering into the general inheritance and particularly applied to that of the flower. Dr. Goodspeed has used certain horticultural varieties of tobacco for the basis of this work, but certain facts have also been derived from a study of various hybrids of commercial tobaccos as well.

The second series of studies is being made under the direction of Dr. Goodspeed with the help of Mr. Ayres into the behavior of sterile and partially sterile hybrids. A preliminary report has already been made on this subject and Dr. Goodspeed enumerates below some of the details of the work which is going on at present.

The third series of experiments concerns itself with the fixation of hybrids. This work is already in its fifth season and is dealing with the third and fourth hybrid generations between different varieties of the commercial species—namely *Nicotiana Tabacum.* It is estimated that an additional season will bring this work to completion, and it is already in process of preparation for publication.

The fourth series of experiments is concerning itself with the common peasant tobacco of Europe and the behavior of hybrids between the different varieties. The second hybrid generation was studied during the present season and the results have been presented by Mr. R. P. Brandt as a thesis for his Master's degree.

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* Department of Botany.

The fifth series of studies concerns itself with various hybrids between certain species of tobacco which either grow wild in California or were cultivated by the Indians of the northwestern region. These studies concern themselves with the transmission of capsular characters as indicated by the number and position of the cells of the capsule. In making the capsule count, I have for the past season employed Mr. R. P. Brandt, who has made the counts and tabulated the results.

As a sixth series of studies there may be included the continued observation of the parents of the various hybrids, together with a general stock of species for future experimentation. Various data have been accumulated in connection with these plants, and statistical tables are being prepared in connection with some of them. New crosses are being constantly attempted and a few are promising to yield interesting results.

Below is tabulated the work which has been going on in the present season:

First Series.—Continuation of the *Nicotiana acuminata* flower size hybrids into the F3 generation. Some 4000 measurements were taken upon hybrids and parents, which, with over 6000 measurements previously taken upon the F1 and F2 generations, constitute as large a mass of data upon the inheritance of a quantitative character in plant hybrids as has been reported upon in genetics literature up to the present time.

Second Series.—Continuation of the studies upon the F1 semisterile hybrids of *N. tabacum* varieties and *N. sylvestris*. Twelve groups of hybrids were grown and a very considerable mass of data which dealt with the general ''stimulating effects of heterozygosis'' and the extent of variation in F1 was accumulated. The nature of the semisterile character of these hybrids has been taken as the subject for a Ph.D. thesis by one of the graduate students in botany. He conducted numerous experiments in the field in the effort to bring about germination of the hybrid pollen and to cut down the premature falling of the hybrid flowers. His experiments are at present being continued in the conservatory with the same general ends in view.

Production of new hybrids by crossing the parents back upon the F1 N. Tab. x N. syl. hybrids. Two groups of hybrids were raised which exhibited certain points of some theoretical interest. Certain individuals among them may prove to be of horticultural interest. This particular series is to be investigated on a larger scale during the season 1914.

Third Series.—Fixation experiments. During this fifth season plants in the pure line of the third and fourth hybrid generation representing some four different crosses and their reciprocals were grown in twenty-four families, a total of 1460 plants. Much assistance was obtained from Mr. R. L. Pendleton in taking the necessary measurements. Photographs were also taken of the important types. It is hoped during the coming season to grow an equal number of pure line plants from members of these different families to test the fixation which seems already certain.

Fourth Series.—Seven families of the second hybrid generation of a cross between two varieties of *Nicotiana rustica* and its reciprocal were grown and 602 plants were measured, correlated and reported upon by Mr. R. P. Brandt. His manuscript is deposited in the University Library as a thesis for the degree of Master of Science.

Fifth Series.—Eight families representing in all 707 plants of the third hybrid generation of crosses between *Nicotiana Bigelovii*, a common wild tobacco of the middle Californian region and one much used by the Indians in earlier days, and *Nicotiana multivalvis*, a species known only from Indian cultivation, were grown and allowed to ripen their capsules. The capsules of each plant have been removed, cut open and the number of cells counted for each. The number of capsules range from 10 to 550 per plant. The data thus resulting have already reached a very considerable amount, but the count for the 1913 season is not yet completed. Mr. Brandt is at present working upon it.

Sixth Series.—Somewhere about twenty-three different species, together with a considerable number of different varieties including the parents of hybrids already made and of all other species of which seed could be obtained, have been grown in numbers varying from ten to one hundred. The work on this stock has been of a somewhat miscellaneous character, but two lines of work may be mentioned, carried on particularly under the direction of Dr. Goodspeed:

Statistical analysis of two of the pure lines among the N. Tab. varieties-N. Tab. var. macrophylla and N. Tab. "Maryland." Considerable data as to flower size, height of plant, number and size of leaves, etc. A number of particular points were investigated which have given results of theoretical interest.

Many new crosses were attempted, chiefly species crosses, most of which were unsuccessful. Hybrid seed was in one case produced, and it will be the starting point for a further investigation of the inheritance of flower size.

The work already outlined and partially under way for the present year 1914 may be indicated as follows:

The Work Under the Direction of Dr. Goodspeed.

I.—(A) 13 F2 H38–F3 plants to go into the field this year. The pedigree of 13 F2 H38 is as follows: F1 H38 = 22/07 ♀ × N. sylvestris ♂, made by W. A. Setchell in 1911, was first grown in 1912 and over 800 capsules of unprotected seed were collected at the end of the season. Plants from this common seed flowered in the greenhouse in March, 1913. All were bagged for pure seed and seed from the fertile plants is now being germinated. I hope to see in the field as many as 50 F3 plants from each of 10 numbers.

(B) 13 F1 H38–F2 plants to go into the field this year. 12 F1 H38 were cut back and flowered again in 1913. A number of capsules of unprotected seed were again collected at the end of last season (1913). This seed is being germinated and will give a small number of F2 plants.

The seed of all of the F2 greenhouse plants (see A) was germinated last fall and 65 plants are now in flats in the propagating house. They show a remarkable uniformity for 22/07 leaf shape. In general I am hoping that from these possibly much involved and uncertain pedigrees we may get some groups of uniform F3 or possibly F2 types fixed. Under any circumstances this particular phase of the experiments seems of sufficient interest to be followed through another season (1914).

II.—(A) 13 F1 H121–F2 plants to go into the field this year. H121 = 11 F1 H34 ♀ × 11 N. sylvestris, made by W. A. Setchell in 1911. Eighteen F1 plants flowered in the field during 1913 and contained some unusual and interesting types. The pure seed of all fertile plants of this hybrid is being germinated, and I am anxious to see as large a number of the F2 plants as possible.

(B) 13 F1 H124–F2 plants to go into the field this year. H124 = 12 F1 H38 ♀ × 12 N. sylvestris ♂. I made this cross in the greenhouse in February, 1913. Seventeen F1 plants flowered in the field in 1913 and were as unusual and interesting as those 13 F1 H121 (A above). As many numbers of pure seed as were obtained are being germinated.

(C) H40 ♀ × N. sylvestris—F1 plants to go into the field this year (H40 = 11 110/05 ♀ × 11 N. sylvestris ♂, made by W. A. Setchell in 1911). This cross I made in the greenhouse in November, 1913, on a potted plant transplanted from the field.

In these three groups (II, A, B, C) I am interested to see the progeny of the unusual F1 populations. It cannot fail to be of general interest and there may be further plants of horticultural interest produced which will be more perfectly fertile. In C—the F1 H40 ♀ × N. syl. ♂ cross—I am very much interested to see whether or not with two "doses" of N. syl. anything of the N. calycina flower type will be lost. It was not as intense in F1 H40 as in 110/05. I want to try to keep breeding the N. syl. against the calycine flower character to see if we cannot eliminate it entirely. This hybrid may also be of interest in connection with III, which follows.

III.—13 78/05 seed from a "calycine" flower. A considerable number of abnormal single and double flowers were formed on all of some 75 plants of 13 78/05. Many such flowers were bagged and artificially self-pollinated and in many cases were sterile. Unprotected abnormal flowers made seed in some cases. One capsule of seed from a protected abnormal flower is being germinated.

This is the least important or interesting group of the three (I, II, III), since there is little possibility that there was any gametic difference between normal and abnormal flowers. These plants may, however, give a few variants with nearly all abnormal flowers, which might then be crossed with the other N. Tab. varieties, especially 68/07, in the effort to reproduce 110/05. These plants will be of interest when it may seem best to describe the occurrence of the abnormal flowers on 13 78/05 and 13 22/07.

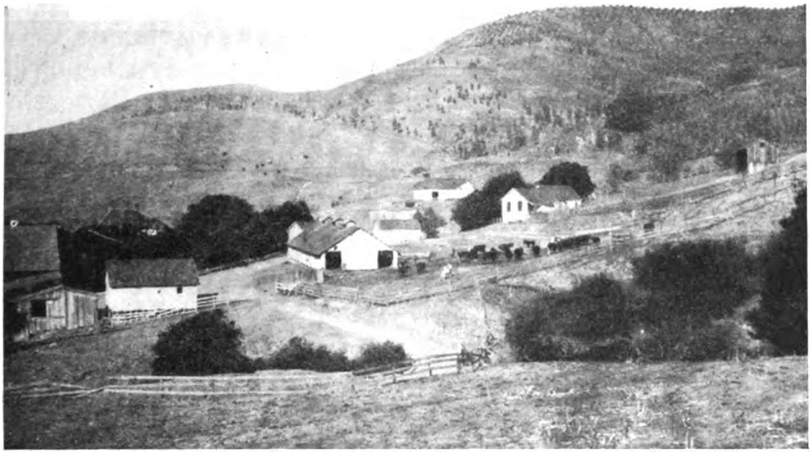
VETERINARY SCIENCE

BY

CLARENCE M. HARING

Tuberculosis in Farm Animals

To stop the spread of tuberculosis and reduce the losses therefrom in the State of California is one of the most important and difficult problems which this Agricultural Experiment Station is attempting to solve. As an aid in formulating effective plans for investigation a conference of experts on bovine tuberculosis was held at Berkeley on July 11 and 12, 1913, which was attended by a number of veterinary officials and sanitary experts. Dr. V. A. Moore of the New York State Veterinary College and Dr. M. P. Ravenel of the University of Missouri were the principal speakers. As a result of this conference plans were outlined and embodied in project form. On account of the difficulty in securing a competent experimental pathologist, the laboratory end of the work has been retarded. Nevertheless, a start has been made and the results of this work are summarized in this report.



University of California Experiment Station for the study of tuberculosis in farm animals.

The Immunization of Calves against Tuberculosis with Bovovaccine. —For several years experiments have been carried on to determine the immunizing value of bovovaccine under California conditions. The preliminary results of this work have been published in veterinary journals from time to time and the results to 1913 were summarized in the last annual report of this station, the conclusion being that von Behring's bovovaccine produces some immunity in calves, but that this does not remain to any appreciable extent after the third year.

It was decided to try the Pearson-Gilliland method of immunization. The vaccine used was the well-known culture Ravenel M reported in the experiments of Pearson, Gilliland and Marshall. Last spring seven calves were vaccinated and have been under observation during the past year. The results are beginning to be apparent. We find this culture to be more virulent than the bovovaccine of von Behring. The vaccinated calves have continued to react to tuberculin, while those we vaccinated with bovovaccine in 1907 ceased to react in eight months.

Infection experiments are now being undertaken to determine the immunity produced, and the results will probably be obtainable in a few months. The results to date of the immunization experiments do not lead us to believe that bovovaccine or any of the similar so-called vaccines for tuberculosis on the market are of any practical value. Stockmen are advised not to use them until further information is obtained concerning their efficiency.

A reaction to the Intradermal tuberculin test. This test constitutes an important step in the control of bovine tuberculosis. A reaction is indicated by a swelling or thickening of the skin at the point of injection. The most suitable place of injection is at the base of the tail.

The Intradermal Test for Detecting Tuberculosis in Cattle and Swine.—Under this project some conclusive results have been obtained which are published in Bulletin No. 243 of this station. This intradermal method has proven very satisfactory in the out-of-door tuberculin testing frequently necessary in this state, and for the non-official testing of large numbers of cattle is preferable to the subcutaneous method. It requires more experience to apply the test and interpret the intradermal reactions than is required in testing by the subcutaneous or ophthalmic methods.

Some tuberculous cattle react locally to the intradermal test, but fail to react thermally to the subcutaneous test, while others which react thermally fail to react locally. Obviously, then, it is necessary to use both tests in order to detect the maximum number of reacting cattle. The introduction of the intradermal method of tuberculin testing is believed to constitute an important step in the control of tuberculosis in both cattle and hogs under California conditions.

A Study of the Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California.—Under this project it is proposed to undertake an extensive study of the conditions under which this disease is spreading. During the past year the work has been directed to trials of methods for detecting open cases of tuberculosis in tuberculous herds. In all 2105 cattle have been given a careful physical examination and the results have been checked by tuberculin tests on every animal, post-mortems in 341 cases and guinea pig inoculation in 41 cases. One of the station veterinarians (Dr. R. M. Bell) has devoted much of his time to the study of the methods for detecting tuberculosis in cattle by physical examination and particularly to trying to pick out by abnormal sounds of the thorax the apparently healthy but tuberculous cattle which have open lung lesions. He has observed that the normal lung tones of cattle having pulmonary lesions are more pronounced during the time that they are reacting thermally to a tuberculin injection. This observation has been put to practical use in co-operative work described under the following project.

Co-operative Experiments in the Control of Tuberculosis.—In co-operation with certain stock owners observations are in progress on seven ranches, including about 2000 dairy cows, 15,000 stock and beef cattle, and 3000 swine. An attempt is being made to apply the known facts concerning the spread of tuberculosis to preventing the spread of the disease on these ranches and the eventual eradication of it. Through these co-operative efforts we hope to work out and demonstrate a system of animal husbandry suited to California conditions which will protect cattle and hogs from tuberculous infection without great expense.

Summary of Tuberculosis Investigational Work.—In addition to the work mentioned above, the veterinarians of this division come in contact with the problems of this disease in dairy certification work, the testing for the Pasadena Board of Health and in the Farmers' Institutes.

The following figures are the combined tuberculin tests by all members of the Veterinary Division for the nine months ending March 31, 1913:

Total number of ranches on which tuberculin tests were made	107
Total number of cattle tested	6004
Total number of cattle that reacted	1831
Percentage of reactors	30

In all, counting retests and tests by various methods applied simultaneously, 9804 tuberculin tests have been made, 6596 of which were by the intradermal, 2745 by the subcutaneous, and 463 by the ophthalmic method. About two-thirds of the tests reported herewith were made for farmers who desired to develop herds of healthy non-reacting animals. Unfortunately the elimination of this disease from a badly infected herd cannot be accomplished simply by testing and removing or segregating the reacting cows. Except in dairies producing certified milk, which brings a high price in the market, it is seldom profitable for a dairyman with a herd containing valuable reacting animals to make the financial sacrifice necessary to completely eradicate the disease. However, the losses from tuberculosis in all classes of cattle and in hogs have reached such proportions that many stock owners are asking for advice. There is great need for further information concerning channels by which this disease is spreading, but if the facts already well known were more generally applied by stock owners there is reason to believe that the losses would be materially reduced Through ignorance or neglect, many dairymen tolerate advanced physical cases of tuberculosis in their herds, and even in the better managed herds it would be possible to improve conditions by pasteurizing the milk fed to calves and by the raising of healthy young stock and keeping them separated from the older infected cattle.

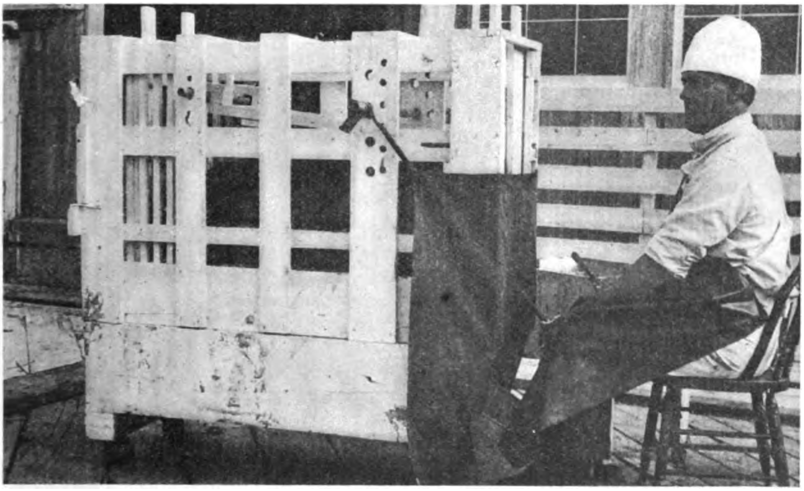
Tuberculin tests and slaughter demonstrations have been conducted at six meetings where large numbers of farmers could see the results, and at every opportunity efforts have been made to disseminate useful knowledge concerning the disease.

The Prevention of Hog Cholera

BY

JAMES F. MITCHELL and WALTER J. TAYLOR

During the year there have been hyperimmunized 350 hogs, 151 of which were bled but once from the throat, 72 once from the tail and once from the throat, 55 four times from the tail, 28 six times, 33 eight times, 9 ten times, and 2 twelve times. We consider that our best results have been obtained by hyperimmunizing a hog for two bleedings, once from the tail and the other from the throat at the time the animal is killed for pork. The two-bleeding method is cleaner than tail bleeding and enables us to post-mortem our hogs before the serum is sold to the farmers. This is important, because in some cases on post-mortem, lesions have been found which have led us to discard serum for fear of internal contamination.

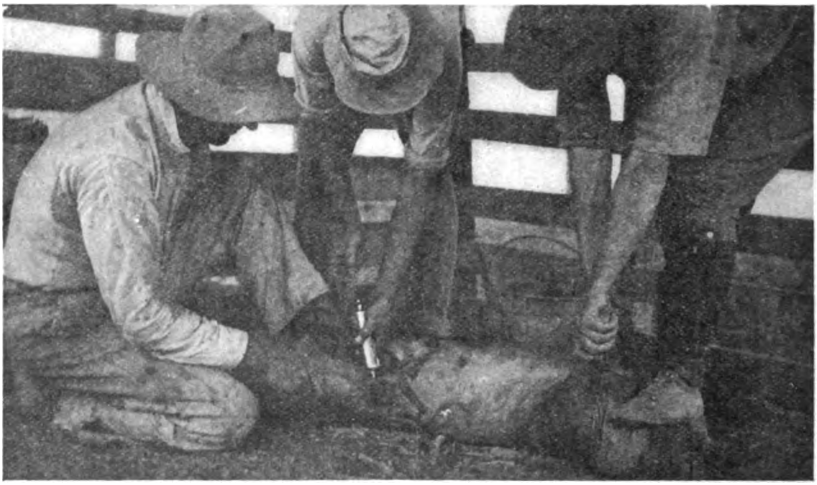


Drawing anti-hog-cholera serum from the tail of a hog at the University of California Hog Serum Laboratory.

Results of the Use of Anti-Hog Cholera Serum.—During the fiscal year ending June 30, 1914, the hog serum laboratory has produced approximately 1,832,000 cubic centimeters of anti-hog cholera serum, of which we have sold 1,079,655 cubic centimeters. Up to July 1, 1913, every hog owner was allowed 500 cubic centimeters free of charge, but since the state appropriation covering this was exhausted at that time the distribution of free serum was discontinued. The following table shows the distribution of serum since July 1, 1913:

TABLE I

Total number of applications received	690
Total number of hog owners that applied for serum	407
Total number cc. of serum sold	1,079,655
Total number cc. of virus sold	12,815
Total number hogs treated	38,450
Total number visibly sick hogs treated	2,915
Total number cases using serum and laboratory virus	271
Total number cases using serum and local virus	121
Total number cases using serum alone	298*
Total number cases using double method	15*
Percentage of well hogs that lived	92.2
Percentage of sick hogs that recovered	23.5
Percentage of well hogs lost	7.8



Immunizing against hog cholera under field conditions. Two men can hold any ordinary size hog in above manner without difficulty.

The percentages in this table were computed from signed reports upon the results of treating 4008 hogs. In practically every instance, with the exception of the University Farm, cholera was present on the premises or in the immediate vicinity.

Statistics prepared by the U. S. Department of Agriculture show that when serum is not used from 40 to 80 per cent of hogs in infected herds die and many of the balance are left in an unthrifty condition. Our table shows that about 92.2 per cent of the well hogs lived and 23.5 per cent of the sick ones recovered. In considering these figures it must be remembered that many of the so-called well hogs were infected with cholera at the time of injection, but showed no visible symptoms. A low estimate of the saving to the hog owners for the past nine months would be $85,000. This is based upon the value of $10.50 per head given in the official estimates of the U. S. Department of Agriculture.* Adding the above amount to the saving for the previous 21 months, the total amount is estimated at $325,000, which would seem an adequate return for an investment by the State of less than $20,000. While the average loss on the entire herd, sick and well, has been something over 10 per cent, reports from individual herds where serum was used before the herd was infected show an average loss of slightly over 1 per cent, while in many cases there was no loss at all.

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* The ten cases that used the double method are also included in the number using serum and virus.

Of the 460 applications, 119 came from the Imperial Valley and the results are reported upon below. Of the remainder, 111 were from Los Angeles and surrounding territory, where there are some of the largest hog ranches in the State, most of the hogs being garbage fed. Many of these ranches are under the control of two large companies and practically every hog on them is vaccinated with our serum. It is upon hogs in this district that the value of the serum has been best demonstrated. They have been able to produce a slight degree of immunity in their pigs, which enables the animals to resist infection to some extent. After the pigs have grown to about 20 to 30 pounds, they are all treated with serum and virus. Reports from the largest hog raiser in this district who vaccinates all his pigs in this way are to the effect that his loss has been less than 1 per cent.

Pigs weighing less than fifty pounds may be conveniently held by one man while being immunized against cholera.

On 36 occasions men have been sent from the station to do the work, and the inoculation of pigs has been demonstrated to fifteen persons who have come to the laboratory in order to learn how to administer the serum. In almost every case the results following the administration of serum by members of the division have been good. The following tables have been made up from reports covering the work for the nine months, which were received from hog raisers in all parts of the State except Imperial Valley. In these tables a check mark in the sick recovered column indicates that no sick hogs were treated. All sick hogs were visibly sick hogs. If temperatures had been taken, it would undoubtedly be apparent that the number of sick hogs treated was considerably greater than the figures given. The average dosage computed from this table is 28 cc., which is very much below what it should be. Our records show that about 40 per cent of the hog owners returned a portion of the serum which they received from us, although no more than was necessary to treat the number of hogs mentioned in the applications was sent to them. About 7 per cent of the animals reported upon in these tables developed abscesses. In some cases these were undoubtedly due to insanitary methods, but it should be borne in mind that an injection of large quantities of liquid, even if sterile, into the tissues of a hog, under the most sanitary conditions obtainable in field work, will be followed by abscess formation in a certain percentage of cases. Out of 1282 hogs treated with serum and virus in herds where no sick animals were injected, only 23 were lost, which makes an average of about 1.8 per cent loss.

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* See U. S. Department of Agriculture Farmers' Bulletin, No. 575.

Nineteen cases where unsatisfactory results followed the use of serum are classified as follows:

TABLE II

Scant dosage and scant dosage on badly infected herd	5
Serum where serum and virus should have been used	2
Serum and virus where serum alone should have been used	6
Insanitary methods	2
Unclassified	4

Scant Dosage and Scant Dosage on Badly Infected Herds.—Even in cases where scant dosage was used on herds where 25 per cent of the whole number were already sick, the figures show that 48 per cent were saved. The average dosage in these cases was 16 cc., which is the dose for suckling pigs for serum alone, and in the majority of these cases serum and virus were used on pigs large enough to have had 45 cc.

Serum Alone where Serum and Virus should have been Used.—In the two cases where serum alone was used followed by heavy loss deaths stopped immediately after the use of the serum, but began again about five weeks later. It was very evident that the immunity had run out and the animals had again become susceptible.

Serum and Virus where Serum Alone should have been Used.—In the six cases under this heading, serum and virus were used on herds which were badly infected, and where, therefore, serum alone should have been used.

Insanitary Methods.—In cases where insanitary methods caused loss, abscesses followed the injection of serum, due to one of the following causes or a combination of all of them: either the work was done in dirty, dusty places, the instruments were not properly sterilized, or the animals were turned into dirty pens while the injection wounds were still open. In one case, which was personally investigated, the veterinarian was given very inefficient help and had to work in an extremely filthy chute.

Reports have been received from a number of cases to the effect that when sows have been vaccinated with serum and virus and, in a few cases, with serum alone, their pigs were borne prematurely or died shortly after birth. For this reason it is recommended that pregnant sows should not be vaccinated if it can be avoided, but if it must be done serum alone should be used.

RESULTS OF THE USE OF ANTI-HOG CHOLERA SERUM IN IMPERIAL VALLEY

TABLE III

Number cc. of serum sold July 1, 1913, to March 31, 1914	207,626
Number cc. of virus sold July 1, 1913, to March 31, 1914	4,127
Number of different ranches	96
Number using laboratory virus with serum	65
Number using serum followed by serum and virus	2
Number times man sent to do work	44

A comparison of the results obtained when a representative of the Veterinary Division did the vaccinating and where others have done the work shows that in the latter case not so good results have been the outcome. This should be qualified by saying that some of these vaccinations have been made by a practicing veterinarian in the valley and his results have been practically as satisfactory as those obtained by the division. The reason for poor results where the owners have done the work themselves lies in the fact that they have not taken the precaution of carefully selecting the affected animals with the aid of the clinical thermometer, thereby vaccinating many affected animals which were too badly diseased for the serum to produce the desired effect.

A few cases have occurred in which poor results have been obtained both by the division and by others, due to the fact that cholera-infected hogs have been vaccinated even when the thermometer failed to reveal the fact to the operator. It is possible for a hog to be sufficiently affected with cholera to prevent the serum from protecting the animal against the progress of the disease, and still the animal will show no rise in temperature.

A pen of small pigs ready for immunization with anti-hog-cholera serum. Pigs of this size have been immunized by simultaneous method for about 30 cents per head. Immunity has lasted until hogs were marketed.

Several cases have occurred in which bad results were apparently due to septicemia (blood poisoning) from causes which it has not been able to specify. Several have apparently arisen from serum and virus which contained a large amount of septic organisms. This is borne out by the fact that, while identical methods were used with both serum and virus when the simultaneous method was employed, septicemia has resulted in some cases where the virus was injected in a sufficiently large number of pigs to indicate that the virus was the cause, while in others the same has held true of the serum.

In a few cases it appears that infection has occurred by allowing the animals to have access to dirty wallow holes immediately after vaccination.

In still others poor results have been reported and a careful investigation of the conditions has shown that insufficient sterilization of the apparatus has been the cause.

Tabulation of Results.—It is not possible to make a complete tabulation of the results obtained during the whole of the year, as very many of the ranchers have not sent in reports as they were requested to do. In going over the reports that have been sent in, it is found that they do not exactly correspond with the results noted upon visiting the ranches where the vaccinations have occurred.

Upon Dr. Taylor's arrival in the Valley, September 10, 1913, he began a card index of all the vaccinations carried out by the station. After a sufficient length of time had elapsed, the ranch was again visited and from talks with the owner and personal observation accurate data upon the vaccinations performed since that time were secured.

In many cases vaccination was advised before the disease appeared. This has resulted in a large number of vaccinations, using the simultaneous method, before the disease appeared.

The following tables are compiled from the vaccinations made by veterinarians from the station during the time intervening between September 10, 1913, and March 31, 1914.

TABLE IV.—HEALTHY HERD

Serum Simultaneous Method

Ranch No.	No. died before vaccinated	No. sick when vaccinated	No. vaccinated	No. died after	Per cent loss
1	0	0	13	0	0
2	0	0	45	0	0
3	0	0	38	0	0
4	0	0	10	0	0
5	0	0	21	0	0
6	0	0	6	0	0
7	0	0	78	0	0
8	0	0	75	0	0
9	0	0	40	0	0
10	0	0	35	0	0
11	0	0	7	0	0
12	0	0	16	0	0
13	0	0	20	0	0
14	0	0	25	8	32
15	0	0	53	2	0.37
16	0	0	36	0	0
17	0	0	40	0	0
18	0	0	11	0	0
19	0	0	9	0	0
			578	10	1.7

TABLE V.—DISEASED HERDS

Serum Alone Method

Ranch No.	No. died before vaccinated	No. sick when vaccinated	No. vaccinated	No. died after	Per cent loss
1	1	1	9	0	0
2	15	0	33	0	0
3	6	15	156	54	35
4	8	10	52	8	15
5	4	2	12	4	33
6	4	2	21	10	48
7	1	2	19	2	10
8	10	8	285	5	1.7
9	6	0	75	20	27
10	1	4	96	17	18
11	6	2	45	18	40
12	6	8	70	10	14
13	3	5	45	4	8.8
14	4	5	49	5	10
15	6	10	110	24	22
16	3	9	190	10	5.2
17	0	3	31	2	6.4
18	4	10	49	8	16
19	4	20	253	26	10
20	0	1	49	0	0
21	0	6	7	6	85
Totals,	92	123	1656	233	19

MISCELLANEOUS INVESTIGATIONS CONCERNING HOG CHOLERA

BY

FRED M. HAYES

Bacterial Examinations of University of California Serum.—Samples of seven different batches of serum that were ready for use showed an average of 46,486 bacteria per cubic centimeter, and about 90 per cent of these appeared to be a species of streptococci.

Supposed sources of contaminating organisms: (1) Circulating blood of the Hyperimmune. Eleven hyperimmunes which showed indications of abscesses, peritonitis and tuberculosis were bled from the tail without external contamination. The blood from these was sterile.

(2) Contamination of the serum during the removal of the fibrin. The same eleven samples of sera indicated in (1) were plated after defibrination. All showed a few bacteria, varying from 11 to 800 cc. Seven of these samples were defibrinated by hand squeezing of the clot. Four samples were defibrinated by a sterilized meat press. The former method gave the highest count. The latter, while not sterile, showed organisms in too few numbers to be indicated by the dilution made.

(3) The effect of 0.5 per cent carbolic acid upon the organisms in the above sera. Samples of the above sera were kept at icebox temperature for 78 days. Examinations were made eight different

If hogs are run through a trough 12×2½×4 feet deep containing a 2 per cent solution of some good coal tar dip, lice will not bother them. Solution must be kept of constant strength for best results.

times during this period, but the results lacked uniformity, and this question remains unanswered from our work. Several samples, however, showed decided multiplication of the bacteria originally present.

Bacterial Examination of Commercial Sera.—Eleven samples obtained from various commercial firms showed an average number of 2,732,881 bacteria per cubic centimeter. Every sample contained organisms, and these were largely streptococci.

Bacterial Examination of State Sera.—Eleven samples from various state stations showed an average of 3,745,100 bacteria per cubic centimeter. Two samples were sterile so far as could be determined by standard aerobic plating methods.

Potency of State and Commercial Sera.—Seven samples, four commercial and three state sera, showing the highest bacterial count, were used to immunize seven susceptible shotes. The doses were those advised by the manufacturer's label. California virus was injected simultaneously in 1 cc. doses. Two controls died of hog cholera and one sample of commercial serum failed to protect.

Conclusions.—1. Practically all anti-hog cholera sera contain living bacteria.

2. California serum showed the lowest bacterial count.

3. A species of streptococci predominated in all sera examined.

4. Hyperimmunes do not give off bacteria in their blood.

5. Organisms enter the serum during the process of defibrination and bottling.

6. Squeezing the serum from the clot by the hand contaminates the serum to a greater extent than the use of some form of sterilized press.

7. It is possible for organisms to multiply in serum preserved in 0.5 per cent carbolic acid.

8. Very little difference in the number of bacteria in the state and commercial sera examined.

9. State and commercial sera are about equal in potency.

10. A high bacterial count does not necessarily predispose to abscesses.

The Determination and Significance of the Spirochaete Present in the Blood of Hogs Infected with Hog Cholera.—The blood of twelve cholera-infected hogs was examined in dilutions of normal salt solutions, one to five and one to ten, by dark field apparatus. Stained preparations were made with Giemsa's stain, Wright's blood stain, and India ink fixation methods. No spirochaetes were observed.

The blood from two cholera-infected hogs was examined almost daily from time of infection to death. No spirochaetes were observed.

Scrapings from an intestinal ulcer in one hog, however, showed spirochaetes.

THE ACTIVITIES OF THE VETERINARY DIVISION AT THE UNIVERSITY FARM

BY

FRED M. HAYES

Maintenance of a Veterinary Clinic for Student Instruction.—Attempt is made to have all possible cases brought to the Veterinary Hospital for observation and treatment, but the division is called upon to respond to many cases of acute sickness that cannot be brought in. The animals owned by the University at the Farm furnish a large part of the clinic material. The out calls and the daily attention that hospital cases and cases on the University Farm frequently require, consume a large part of the time of the veterinarian in charge. A report of the number of cases treated from October 1, 1913, to April 25, 1914, by the Veterinary Division is tabulated as follows.

Horses	79	Dogs	4
Cows	304	Cats	2
Sheep	3	Chickens	2
Hogs	237	Goats	4

Total, 612

Observations upon the Tuberculin Testing of the Cattle and Hogs at the University Farm.—(*a*) Tuberculin testing of the Dairy and Beef Herd: It has been the practice to make annual tuberculin tests of all cattle at the University Farm. The tests for 1914 were made on April 6th and 7th and April 8th and 9th. Both the subcutaneous and intradermal were used. Three previously tested and non-reacting cows reacted to both of these tests. One cow which has reacted three times during the last two years also reacted to the subcutaneous test. The record of these cows is given in the following table:

Injection at 9 P.M., 4/6/14 Temperatures before injection				Date 4/7/14 Temperatures after injection							
Test No.	P.M. 1:30	P.M. 4:30	P.M. 8:00	A.M. 5:00	A.M. 7:00	A.M. 9:00	A.M. 11:00	P.M. 1:00	P.M. 3:00	P.M. 5:00	P.M. 6:00
15	2.2	1.4	1.6	1.1	1.2	2.0	2.9	4.5	4.6	4.2	4.2
									4.46		
19	1.2	1.4	1.3	1.8	1.6	1.9	2.9	3.1	3.2	2.4	2.2
									2.7		
39	2.0	1.7	1.6	1.6	3.0	3.9	4.3	5.3	5.4	5.1	......
							5.1				
113	2.3	4.1	4.0	3.1	4.0	4.8	5.4	5.3	4.9	3.4	......

Intradermal injection at 10 P.M., 4/6/14
Observations 40 to 60 hours after

Test No.	Intradermal	Remarks	Name	Breed
15	+	Size walnut	Minniewawa	Holstein cow
19	+	Size walnut	187	Guernsey
39	+	Size egg	....	Holstein
113	–	....	Lustrous	Shorthorn

History of Reacting Animals.—**No. 15:** Purchased and tested subcutaneously in October, 1913. Reaction negative. Came from a herd in which tuberculosis existed.

No. 19: Purchased and tested in October, 1913. Reaction negative. Came from a herd in which tuberculosis existed, but not from same herd as No. 15.

No. 39: Raised on University Farm and passed annual tests of 1912 and 1913. Stanchioned beside cow No. 15 (above). This fact may account for her infection.

No. 113: Shorthorn heifer "Lustrous" reacted to intradermal test in spring of 1912. Reacted typically to subcutaneous October 26, 1913. This cow is very wild and excitable and her normal temperatures vary. It is possible that the intradermal injection was not properly made on the last test, due to the animal not being satisfactorily confined.

It is interesting to note that in the test of March 12 and 13, 1913, a white Shorthorn cow (No. 201) reacted to the subcutaneous test. Her calf was immediately taken from her. She and the Shorthorn heifer Lustrous were isolated and kept together. A cross-bred calf was allowed to suck these two cows from this time until the white Shorthorn (No. 201) was sold in December, 1913. From December, 1913, until February 4, the calf sucked "Lustrous." On February 4, the calf was sold to the butcher. Post mortem examination did not reveal any indications of tuberculosis. Post mortem examination of the white Shorthorn (No. 201) in December, 1913, revealed extensive generalized tuberculosis.

Tuberculin Testing of Hogs at the University Farm.—In December, 1913, a diagnosis of tuberculosis of the udder was made upon "Queen of U. F.," a Duroc sow. This sow and two others which had fall litters were showing enlargements of one or more mammary glands. Tuberculosis was suspected in these also. The intradermal tuberculin test was applied to all the hogs from February 15 to April 1, 1914.

There has been an opportunity to confirm the tuberculin test results on reacting hogs in two instances to date.

Sources of Infection.—With the exception of Stewart's Advancer, Long Advancer, Hillcroft Susan 3rd, and University Lady, all of the hogs reacting were born on the University Farm. These four hogs were bought in July, 1911, and came to the University as gilts. It is not probable that they were responsible for the spread of the infection. The most logical source of the infection seems to have been the skim milk fed mostly during the summer of 1913. This milk was brought to the creamery from a number of outside farms and no doubt contained tubercular organisms.

It is a fact that with one exception the fourteen large sows that reacted had been fed upon this milk during the summer of 1913; also that the reacting sows were particularly the ones that farrowed in the fall of 1913. On the other hand, the spring pigs (1913) of these same sows failed to react in the test of April 1, 1913, and they too had fed upon the same milk, but in much smaller amounts and for less time.

Immunization of Hogs at the University Farm.—Since May, 1913, the University Farm herd of hogs has been systematically immunized against hog cholera. The frequency of visitors to the hog pen and the showing of some hogs at the fairs render immunization a necessity. A record has been kept of this work, in order that we may have the complete results or effects of immunization in at least one herd. The records are as follows:

May 7, 1913—

Total number of hogs at University Farm	160
Number weighing from 30–60 pounds given serum	112
Number weighing over 300 pounds given serum	40

(Eight shotes to be sold in a few days were not treated.)

May 17, 19, and 20—Serum and virus were administered to the above 152 hogs.

Immediate Effect of Treatment.—There were no indications of cholera, but a few of the large hogs developed abscesses at the point of injection.

Possible Effect of Vaccination upon Breeding.—Of the 112 hogs treated from May 7–20, there remain only twelve sows from which we might draw conclusions as to this point. These hogs were bred in the winter of 1913 to pig in the spring of 1914. The results are indicated as follows:

Name	Breed	No. of pigs farrowed to April 25, 1914
California Pride 2nd	Poland	8 (1st litter).
University Beauty	Berkshire	Did not get with pig.
Sue of U. F. 1st	Tamworth	7 (1st litter).
Sue of U. F. 2nd	Tamworth	11 (1st litter).
*Queen Rival 9th	Berkshire	13 (1st litter).
Matchless Susan 1st	Poland	With pig.
Matchless Susan 2nd	Poland	3 (1st litter).
Matchless Susan 3rd	Poland	With pig.
California Advancer 36	Duroc	14 (1st litter).
Queen of U. F. 2nd	Duroc	6 (1st litter).
Queen of U. F. 3rd	Duroc	With pig.
Advancer of U. F. 4th	Duroc	With pig.

* Reacted to intradermal tuberculin test April 3, 1914.

Of the forty hogs immunized from May 7–20, 1913, the following table will indicate the litters before and after treatment from the hogs on which it has been possible to keep some record:

			Before treatment	After treatment		
Name		Breed	Spring 1913	Fall 1913	Spring 1914	
Long Advancer	+	Duroc	14	16	0 bred	++
Queen of U. F. 1st	+	Duroc	0 bred	7	0 bred	++
Stewart's Advancer		Duroc	10	9	11	++
Princess of U. F.	+	Duroc	8	not bred	10	
Model of U. F.	(1)	Duroc	10	not bred		
Stewart's Sensation	(2)	Duroc				
Miss Advancer of U. F.		Duroc	not bred	not bred	7	++
Missie of U. F.	(3)	Duroc	not bred	0 bred		
Miss Cherry of U. F.	(4)	Duroc	not bred	3		
Happy Girl of U. F.	+	Poland	13	not bred	0 bred	++
Hillcroft Pride	(5)	Poland	12			
Hillcroft Susan 3rd	+	Poland	5	6	10	++
Univ. Farm Sunlight		Poland	10	9	0 bred	++
Univ. Farm Pride	+	Poland	8	not bred	9	
Hillcroft Sunlight		Poland	7	0 bred	0 bred	++
Univ. Farm Pride 3rd	+	Poland	7	not bred	10	++
Early Evening		Poland	7	0 bred	8	++
Grade	(6)	Poland	9	6		
Grade	(7)	Poland	6	0 bred		
Univ. Farm Midnight		Poland	not bred	0 bred	8	++
Matchless Pride 1st	(8)	Poland	not bred	0 bred		
Matchless Pride 2nd	(9)	Poland	not bred	0 bred		
Rockwood Laurel 9th	(10)+	Berkshire	8			
Queen Davis	(11)	Berkshire	10	0 bred		
Grieves Lady Belle		Berkshire	8	not bred	10	++
Duchess 422		Berkshire	9	0 bred	0 bred	
Queen Rival 9th		Berkshire	not bred	5	13	++

+ These hogs were treated with serum alone in October, 1912, after being brought from the State Fair. All developed large abscesses.

++ Hogs that reacted to the intradermal tuberculin in March or April, 1913.

(1) Died in October. Suspected tuberculosis.
(2) Has never been bred. Period of oestrum irregular.
(3) Sold during winter of 1913–14.
(4) Sold during winter of 1913–14.
(5) Sold June, 1913.
(6) Sold during winter of 1913–14.
(7) Sold during winter of 1913–14.
(8) Sold during winter of 1913–14.
(9) Sold during winter of 1913–14.
(10) Died three days after vaccination of May, 1913. Diagnosis not made.
(11) Sold during winter of 1913–14.

Name	Breed	Before treatment Spring 1913	After treatment Fall 1913	After treatment Spring 1914	
Queen Davis of U. F. ......(12)	Berkshire	not bred	10		
Univ. Farm Laurel	Berkshire	not bred	not bred	10	++
Royal Beauty 149 ....(13)	Berkshire	8	0 bred	12 aborted	
Lady Premier 140 ....(14)	Berkshire	9	10	11	++
University Lady	Tamworth	9	10	11	++
University Co-ed ....(15)	Tamworth	11	0 bred		++

++ Hogs that reacted to the intradermal tuberculin test in March or April, 1913.

(12) Sold during winter of 1913–14.
(13) Hurt in dipping. Paraplegia developed.
(14) Died one month after vaccination in May. Heat prostration.
(15) Sold during the winter of 1913–14.

Comparing the number of offspring from sows that had been bred both before and after the vaccination of May 7 and 17, 1913, we note that from fifteen sows the offspring for the spring, 1913, just before vaccination, was 128 and the offspring from the same sows for the fall of 1913 was 63. This was a decrease of about one-half. The relation may be seen in the following table:

Before treatment of May, 1913.	1	2	3	4	5	6	7	8	
Spring litters of 1913......	14	0	10	13	5	10	7	7	
After treatment of May, 1913—									
Fall litters of 1913..........	16	7	9	0	6	9	0	0	
Before treatment of May, 1913	9	10	11	12	13	14	15		
Spring litters of 1913......	9	6	10	9	8	9	11		=138
After treatment of May, 1913—									
Fall liters of 1913..........	6	0	0	0	0	10	0		= 63

For the comparison of the number of offspring from sows that had been bred for pigs before the vaccination of spring, 1913, and the offspring from the same sows in the spring of 1914, there are fifteen, of which we have a record as follows:

Before treatment of May, 1913.	1	2	3	4	5	6	7	8	
Spring litters of 1913......	14	0	0	8	13	5	10	7	
After treatment of May, 1913—									
Spring litters of 1914......	0	0	11	10	0	10	0	0	
Before treatment of May, 1913.	9	10	11	12	13	14	15		
Spring litters of 1913......	8	7	7	8	9	8	9		=123
After treatment of May, 1913—									
Spring litters of 1914......	9	10	8	10	0	12	11		= 91

NOTE.—Of the six sows that did not farrow this spring (1914) four reacted to the intradermal tuberculin test.

Comparing the total number of pigs farrowed from untreated sows in spring, 1913, and from treated sows in fall, 1913, and spring, 1914, we have the following:

Spring	1913	from 22 sows	187 pigs.	Average per sow	8	plus
Fall	1913	from 21 sows	81 pigs.	Average per sow	4	minus
Spring	1914	from 19 sows	129 pigs.	Average per sow	6	plus

The figures above show a very apparent descrease in offspring from sows that have been vaccinated. *That this decrease is not caused entirely by vaccination but is largely due to a difference in herdsmen that were looking after the feeding and breeding of the hogs, is believed by the writer.* When these large hogs were bred in the spring of 1913 for pigs in the fall (where the decided decrease occurs), many of them had abscesses developed or developing. Some of the abscesses were severe and caused considerable sloughing of tissue in the hams. This may have contributed to the failure to breed or produce normal litters.

In the spring of 1914, there is an increase in pigs from the same sows, but it has not reached the normal. This may be explained by the fact that of the six sows that failed to breed, four of them reacted to the intradermal test for tuberculosis. Furthermore, the Poland boar used for service in the fall of 1913 was purchased late in the fall and some of the sows which did not get in pig at the first or second service were allowed to go over until spring.

Vaccination of Fall Litters, 1913.—In November, 1913, there were fifty-four pigs from fall litters that had not been immunized. These were from immune mothers and weighed from 20 to 50 pounds at the time of treatment. Serum alone was administered November 22, 1913. The serum and virus was given, using 15–20 cc. of serum (Nos. 34 and 38) and 0.5 cc. of virus, on December 2, 1913.

Results and Conclusions from Vaccination of Fall Litters, 1913.—On December 26, 1913, twenty-six pigs had developed abscesses at the point of injection. The serum alone was administered into the right ham; the virus on the second treatment was also given on the right side, and the serum on the left. Most of the abscesses developed on the right side. Abscesses developed in the following pigs:

Duroc-Jersey	(7)	Nos. 63, 61, 62, 57, 59, 55, 52.
Poland-China	(8)	Nos. 65, 60, 55, 56, 50, 52, 51, 54.
Berkshire	(8)	Nos. 57, 60, 59, 51, 50, 53, 56, 55.
Tamworth	(2)	Nos. 52, 53.
Grades	(1)	No numbers.

From the fact that abscesses occurred in both the right and left hams, we are certain that the infection was either carried into the serum injection wound by the needle, entered through the wound after injection, or was in the serum itself. Unfortunately abscesses seem to be an unavoidable acompaniment of the serum treatment. In many instances the abscesses can be properly accounted for by injection of serum with dirty instruments and filthy surroundings in which the operator has to work and in which the hogs live after treatment. In other instances these conditions do not exist and yet abscesses develop. The abscesses above referred to are examples of such results. The conclusion we must reach is that certain bottles of serum have pus-producing organisms in large numbers in them, or that the serum containing the carbolic acid and many corpuscles acts as an irritant to the muscle tissue into which it is injected, destroys some of the tissue and results in an abscess similar to an abscess that might be produced from a bruise, without the breaking of the skin and introduction of organisms from the exterior.

ACTIVITIES OF THE VETERINARY DIVISION IN SOUTHERN CALIFORNIA

BY
WALTER J. TAYLOR

Upon arrival in the Imperial Valley on September 10, 1913, it became at once apparent that cholera in hogs was the most important subject upon which to fix attention. In comparison with previous years, many were discontinuing the hog industry, due in great part to the prevalence of this disease, which had depleted many herds. Inquiry into the immediate cause of this condition brought the fact that it was the custom among the farmers not to immunize the animals until the disease had begun to appear in the herds. Instruction was given relative to the importance of immunizing before any cholera was present. This has been fruitful of results in a great many cases, as the report submitted under hog cholera will show.

In order to secure the best results in vaccinating hogs against cholera, it was necessary to visit as many places as possible from which requests for anti-hog-cholera serum came. It was found that the cause for many of the apparently poor results in the use of the serum came from the fact that a proper knowledge of the method of application was lacking. When it is clearly understood that the serum is to be used as a preventive and not as a therapeutic agent, sick hogs are not vaccinated, and thus better satisfaction is secured in its application. As a result of this condition, many more applications for advice concerning vaccination as well as requests for the actual performance of the work came in than one man could attend to, and it became necessary to put a second veterinarian in the field. This work has led to a gradual increase in the swine industry of the valley, and many more hogs are being raised than there were six months ago, and some who had discontinued the business are again taking up the industry.

In November, 1913, a request came to the Veterinary Division from a dairyman in Los Angeles County for co-operation in ridding his herd of tuberculosis. On November 2–6 the intradermal test was applied to 819 animals for this man. The reactions obtained showed that 71.4 per cent of the herd were infected with tuberculosis. A system of isolation of affected animals was established, the milk fed to the heifer calf offspring pasteurized, while some of the original cows were sold for beef under proper inspection, and the premises were thoroughly disinfected. At the present time 25 per cent of the original reacting animals have been disposed of, some eighty-five heifer calves have been produced from the reacting and non-reacting cows, while no more animals other than the progeny of the original stock have been added to the herd. It is the intention to replace the former number of producing animals by careful attention to the offspring. This will take several years to accomplish.

Late in November, 1913, co-operative work with the City of Pasadena was undertaken relative to the tuberculin testing of cattle furnishing milk to that city. The City Council turned over to the University the money available for the work at that time, which was $778 and which appropriation expires July 1, 1914. According to the city ordinance No. 765, only the subcutaneous method of testing is applied. Up to April 1, 1914, 354 animals had been tested. These were located upon forty-eight different farms. The reason for the large number of farms is accounted for by the fact that very many one-cow dairies are in operation in the city. The application of the subcutaneous test under these conditions makes the work more difficult.

Herds in several counties have been examined for the presence of infectious abortion in cattle. In all cases reports from the laboratory at Berkeley have shown the disease to be present. Advice as to isolation, disinfection, and treatment have been given in all cases while further investigations are under way. This disease being one concerning the treatment of which nothing definite is known, the progress is necessarily slow.

Some attention has been given to diseases of live stock in Imperial County under the term of Miscellaneous Investigations Concerning Disease. Thus Dermatitis has been studied to some extent, paralysis in hogs and a condition commonly called "smallpox" in young pigs has been seen. Further studies on these conditions are being carried out.

In Bulletin No. 219 of this station, Dr. C. L. Roadhouse has described, under the name of "Necrotic Dermatitis," a disease of pigs which causes great loss in this valley. On one ranch where there are severe losses among little pigs we are making a careful study of the conditions which may contribute to its existence and spread, and are trying various remedial measures. By animal inoculation and microscopic examination of tissue from the infected pigs, we have proved the presence of *Baccillus necrophorus,* a pathogenic organism which is probably the specific cause of the trouble.

Dairy Certification

BY

CHESTER L. ROADHOUSE

Since July 1, 1913, the College of Agriculture has undertaken the supervision of the production and handling of certified milk for the Alameda County and San Francisco County Medical Milk Commissions.

The Veterinary Division has in charge the inspections, sanitary supervision, bacteriological examinations and tuberculin tests of all dairies certified to by these milk commissions.

The Nutrition Division has charge of the chemical examinations of the certified milk, a report of which will be submitted by Professor Jaffa.

Dairies Supervised and Their Production

Name	Location	No. cows milking		No. quarts per day	
Walnut Grove	San Jose	110		1,000	
Sleepy Hollow	San Anselmo	180		1,457	
H. R. Timm	Dixon	249		2,504	
Dixon (Hutton Bros.)	Dixon	171		1,196	
University of California	Berkeley	24	milk	215	
			skim milk	16	
			cream	5	pints
San Ramon	Walnut Creek	90		614	
Total certified milk produced				7,002	

About 3 per cent of the milk delivered in the bay cities is certified.

The following is the procedure in the supervision of certified milk:

1. Monthly veterinary inspection at each dairy to observe and advise in the health of the herd, health of employees, condition of equipment, methods and sanitation.
2. Monthly dairy inspections by another member of the division to observe methods and sanitation.
3. Semi-monthly bacteriological examinations of samples of milk from each dairy collected from delivery wagons.
4. Semi-monthly chemical examinations of samples of milk from each dairy collected from delivery wagons.
5. Semi-annual tuberculin testing of all animals kept on certified dairy farms.
6. Tuberculin testing of all animals purchased by certified dairies before they are taken to the certified dairy farms.
7. The supervision of the inspector and his reports on the weekly inspections of milk depots and delivery wagons to observe icing and handling of certified milk in Alameda County.

The total number of bacterial examinations of certified milk for the year was 355.

It is worthy of note that of the 305 examinations for the dairies *regularly certified* that only 4.9 per cent were above the requirement.

The average bacterial count for each certified dairy is shown in the following table:

Name of dairy	County sold in	Average bacterial count for the year
Dairy No. 1	Alameda	4,235
Dairy No. 2	San Francisco	8,024
Dairy No. 3	Alameda	9,251
Dairy No. 3	San Francisco	7,697
Dairy No. 4	Alameda	6,134
Dairy No. 4	San Francisco	5,527
Dairy No. 5	Alameda	5,743 (milk)
		5,103 (skim milk)
		6,608 (cream)
Dairy No. 6	Alameda	4,233
Dairy No. 6	San Francisco	5,268

The following are the results of tuberculin tests of animals for certified dairies:

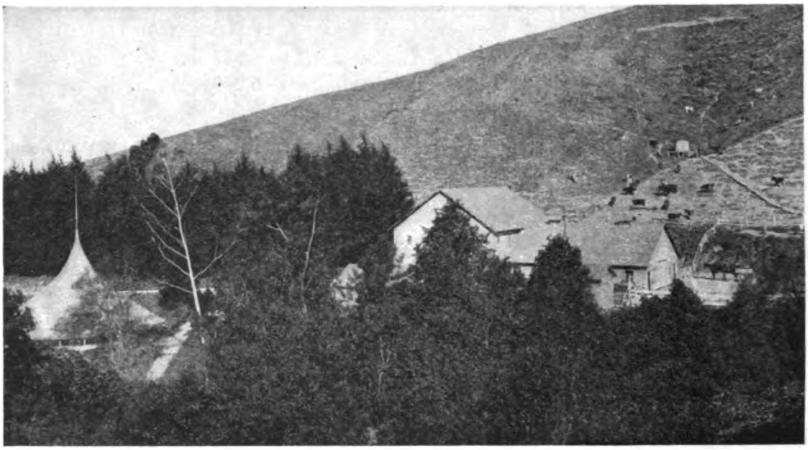
DAIRY No. 1	No. of cows tested	No. condemned	Per cent
Semi-annual test	133	1	.7
Purchased since July 1, 1913	49	0	.0
DAIRY No. 2			
Semi-annual test	259	12	4.6
Purchased since July 1	22	2	9.09
DAIRY No. 3			
Semi-annual test	315	2	.6
Stock raised on place	64	0	.0
Tested and not accepted	9	1	11.1
DAIRY No. 4			
Semi-annual test	119	11	.9
Purchased since July 1	135	6	4.4
Tested and not accepted	9	7	81.0
DAIRY No. 5			
Semi-annual test	35	1	2.8
Purchased since July 1	4	0	.0

Dairy No. 6

Semi-annual tests	66	2	3.0
Purchased since July 1	176	5	2.8

Total number of animals tested at semi-annual tests	927
Total number of animals condemned at semi-annual tests	29
Per cent condemned at semi-annual tests	3.1
Total number of animals purchased	395
Total condemned from purchased animals	31
Per cent condemned of purchased animals	7.9

In sanitation and in all other respects the certified dairies are well within the regulations prescribed by the milk commissions of the county medical societies, and they are of great value as an example of good dairying to others throughout the state.



The University maintains a certified dairy at Berkeley.

The University of California Certified Dairy.—The policy of the University of California Dairy at Berkeley is to demonstrate the methods for clean milk production to students and others, and in view of this a course of instruction was given in sanitary milk production during the fall semester, in which the students were required to take part in the regular work at the dairy in the feeding and milking of animals, straining, cooling and bottling of milk, the washing and sterilizing of apparatus, cleaning of buildings, etc. The University Dairy being close at hand made it possible for this practice work to be given at Berkeley.

To improve the quality of the product an automatic bottle-capping machine and a complete set of metal-lined delivery cases have been installed. The University Dairy herd now numbers thirty-five head of cows, six two-year-old heifers, one yearling heifer and one calf.

The dairy delivers daily to the faculty and others, on an average of 215 quarts of milk, sixteen quarts of skim milk, and five pints of cream. In additon to this, an average of 675 pounds of butter per month, purchased from the University Farm Creamery at Davis, were distributed in Berkeley at an average selling price of 38¼ cents per pound.

During the year calves were sold at a total price of $113.34. Miscellaneous sales of cow-hides, sacks, etc., amounted to $95.40.

The dairy receipts for the fiscal year 1913–14 follows:

Total milk receipts	$9,839.55
Total butter receipts	3,238.90
Total skim milk receipts	221.45
Total cream receipts	611.10
Number of pounds of butter received from University Farm	8,700
Amount paid for butter received from University Farm	2,678.40

The average butter fat content of certified products was: Milk, 3.9 per cent; skim milk, .3 per cent; cream, 29.2 per cent. The number of bacteria per cubic centimeter was determined semi-monthly, with the following average results:

Milk,	5,743	Skim milk,	5,103	Cream,	6,608

The Medical Milk Commission allows:

Milk, 10,000	Skim milk, 10,000	Cream, 30,000

DAIRY BACTERIOLOGY

BY

CHESTER L. ROADHOUSE

In addition to routine bacterial counts of milk, certain investigations have been completed. The investigations consisted in the examination of one hundred samples each of milk, skim milk, and cream, the milk originating from different sources. Mr. R. S. Adams, a student in the College of Agriculture, has carried on this work, which is reported upon as follows:

1. Distribution of Bacteria from Clean Fresh Milk (Certified)—
   35 examinations made, showing the average bacterial count for the milk to be 3,683, skim milk 3,449, and cream 3,697.
2. Distribution of Bacteria from Fresh Market Milk—
   30 examinations were made, showing the average bacterial count for the milk to be 50,503, skim milk 35,597, and cream 76,470.
3. Distribution of Bacteria from Aged Market Milk—
   35 examinations were made, showing the average bacterial count for the milk to be 1,770,386, skim milk 1,484,571, and cream 2,212,837.

When milk is separated by means of a centrifugal separator, it is found that different proportions of the bacteria in the original whole milk will be distributed in the resulting skim milk and cream. This proportion varies in different samples of milk having the same bacterial content per cubic centimeter, especially if they were produced and kept under different conditions. This variation may be due to a difference in the specific gravity of the individual organisms found in the milk, or to physical or chemical differences in the milk.

Conclusions.—1. The proportion of bacteria distributed from whole milk into skim milk and cream by means of a centrifugal separator varies in different classes of milk.

2. The skim milk and cream resulting from the separation of fresh certified milk each had a bacterial content about equal to that of the original milk.

3. The skim milk resulting from the separation of fresh market milk contained 29.5 per cent less bacteria per cubic centimeter and the cream 51.4 per cent more bacteria than the milk from which it was separated.

4. When old market milk was separated, the resulting skim milk contained 15 per cent less bacteria and the cream 25 per cent more bacteria than the whole milk.

VITICULTURE AND ENOLOGY

BY

FREDERIC T. BIOLETTI

In addition to the investigational projects of this division included on pages 26–35, the following minor researches have been conducted:

1. Toxic effect of metallic salts on wine yeast (*Saccharomyces Ellipsoideus*).
2. Study of causes of spoiling of canned fruits and vegetables.
3. Sweet wine experiments—
    (*a*) Test of varieties of grapes for sweet wines.
    (*b*) Methods of manufacture to develop processes that will require less alcohol for fortification than is now used.
4. Methods of wine analysis (in conjunction with laboratory of Italian-Swiss Colony).
5. Effects of use of sulfurous acid and pure yeast on stability of wines.

Advanced students have conducted researches as shown below:

1. J. P. Zavalla—Technology of Canning and Causes of Spoilage of Canned Fruits and Vegetables. (M.S. thesis.)
2. L. L. Lieb—Orange By-Products, Methods of Peeling Oranges and Lemons.
3. M. Matsumoto—The "Tourne" Disease of California Wines, and Methods of Control. (B.S. thesis.)
4. J. R. Zion—Pure Yeast and Sulfurous Acid in Fermentation of Apple Juice for Production of Vinegar.
5. E. M. Brown—Sweet Wine Investigations. (B.S. thesis for December, 1914.)
6. H. H. Pandya—Orange Products.
7. A. V. Sifredi—Apple Products: Vinegar, Unfermented Cider.

This division has, in addition to its instruction and research work, engaged in the following activities of public interest:

1. Samples of wine analyzed and advice given for handling same	231
2. Number of people for whom above examinations were made	37
3. Cellars and factories visited at request of owners	8
4. Samples of cider and vinegar examined for vinegar manufacturers	20
5. Number of people for whom above examinations were made	5
6. Cause of spoiling of unfermented cider investigated and remedy suggested.	1
7. Cause of peculiar flavor in 300,000 gallons vinegar located	1
8. Number of vinegar factories in which pure yeast and sulfurous acid were introduced	2
9. Number of people to whom advice was given on orange products	8

10. Number of wineries in which pure yeast and sulfurous acid were demonstrated or introduced	9
11. Number of winemakers, vinegar manufacturers, alcohol manufacturers, public institutions receiving pure cultures of yeast or bacteria	27
12. Miscellaneous products examined: olive oil, jelly, swelled peas, olive pomace, near beer, patent medicine, etc.	20
13. Cuttings of rare or new varieties of vines sent to growers	62
14. Samples of vines, olives, etc., sent by growers examined and reported on.	98

In the following paragraphs is given a summary of the more important or interesting results of the research work of the Division of Viticulture and Enology during the past year.

Effects of Early and Late Pruning of Vines.—Experiments were made in three bearing vineyards: one of Petite Sirah near Woodbridge; one of Zinfandel near Modesto, and one of Muscat at the University farm, with the following results:

Effects on Starting of the Buds.—1. Pruning before the leaves fall in autumn delayed starting of buds slightly.

2. Vines pruned when most dormant started first.

3. Delayed pruning until the terminal buds start delayed the starting of the buds near the base of the canes.

4. Delayed pruning until March 13 saved the crop from a frost occurring on April 21.

5. Whitewashing the vines after pruning delayed the starting slightly.

Effects on Blossoming.—1. Late pruning, after starting of buds, delayed blossoming.

2. When early pruning resulted in frost injury, the late pruned vines blossomed first.

Effects on Crop.—1. Frost injury in spring diminished crop of early pruned vines.

Average crop early pruned vines (Davis)	13.44 lbs.
Average crop late pruned vines (Davis)	18.64 lbs.

2. Pruning after terminal buds had started seemed to increase the crop irrespective of frost injury. (Exp. 5, 6, Davis.)

Average crop of vines pruned March 14	17.72 lbs.
Average crop of vines pruned April 14	22.55 lbs.

3. Pruning after the shoots had grown several inches seemed to diminish the crop. (Exp. 6, 7, Davis.)

Average crop of vines pruned April 14	22.65 lbs.
Average crop of vines pruned May 14	15.28 lbs.

4. Late pruning delayed the ripening.

Average composition of crop of early pruned vines—
26.6° B; .44 per cent acid.
Average composition of crop of late pruned vines—
23.7° B; .53 per cent acid.

The higher acidity of the grapes of the late pruned vines indicates later ripening and not final lack of sugar.

5. Pruning in May decreased the quality of the grapes.

Composition of grapes from vines pruned in March 14, April 14—
23.7° B; .56 per cent acid.
Composition of grapes from vines pruned in May 14—
23.7° B; .48 per cent acid.

The lower acidity of the grapes from the vines pruned in May indicates lack of proper development.

6. Frost injury in spring did not increase the second crop of Muscat.

Disinfection of Cuttings and Rooted Vines by Immersion in Hot Water.—The disinfection of rooted vines, suspected of being infested with phylloxera, by means of carbon bisulfid is uncertain and liable to injure the plants. Tests were made to determine whether disinfection could not be accomplished with certainty without injury to the vines by immersing in hot water. The temperatures and times fatal to the phylloxera and its eggs and the limits supported by the vines were determined. The following is a summary of the results:

Rooted vines may be safely heated to 60° C for 1 min.
Rooted vines may be safely heated to 55° C for 5 min.
Rooted vines may be safely heated to 50° C for 10 min.
Cuttings may be safely heated to 55° C for 5 min.
Cuttings may be safely heated to 50° C for 10 min.
Phylloxera eggs are killed by 50° C for 1 min.
Phylloxera (root form) killed by 50° C for 3 min.
Phylloxera (root form) killed by 55° C for 1 min.

Conclusion.—Either cuttings or roots may be safely disinfected by immersion in water at 55° C for five minutes.

Relation of the Degree of Ripeness of the Grapes to the Quality and Quantity of the Crop of Raisins.—Much uncertainty exists among raisin growers as to the most profitable stage of ripeness at which to gather Muscat grapes for drying. The problem has three aspects: (1) the effect on the quality of the raisins; (2) the effect on the total quantity of the crop, and (3) the relation to weather and labor conditions. The first two aspects were investigated by gathering five trays of Muscat grapes in the same vineyard at various degrees of ripeness represented by different Balling degrees of the juice from 20° Bal. to 29° Bal.

The following table has been calculated from the results:

Bal. of grapes	Ratio G/R	Increase of crop	Quality	Returns	
				Gross	Net
21	4.15	100	90.0	100.0	100.0
22	3.96	105	......	105.5	
23	3.76	111	......	112.2	
24	3.57	117	91.5	119.9	148.6
25	3.37	122	......	127.8	
26	3.18	128	97.0	138.0	163.8
27	2.98	134	......	144.0	
28	2.79	139	......	149.0	
29	2.60	145	96.5	155.5	197.0
30	2.40	......	......	....	
31	2.21	......	......	....	
32	2.01	......	......	....	

G/R = Ratio of weights of fresh grapes and raisins.

This table shows that grapes of 29° Bal. yielded 60 per cent more raisins than grapes of 21° Bal., and that the increase of crop of raisins per acre corresponding to this increase of ripeness was 45 per cent. The quality of the various samples was estimated from the reports of five expert commercial raisin buyers. The gross returns were calculated by multiplying the crop by the quality, and show a gain of 55.5 per cent in favor of the ripest grapes. The net returns or profit exceed this, as the cost of production per pound of raisins decreases with the increase of crop per acre, and may be fairly estimated to be 97 per cent higher for the ripest grapes.

This is strong evidence in favor of the advisability of allowing Muscat grapes to become very thoroughly ripe before gathering for raisins. The gain is so marked that it would well cover much extra expense for occasional "stacking" or even partial loss of the crop in seasons of early rains.

Cap-Stemming Sultannia Raisins.—In the preparation of Sultannia (Thompson Seedless) raisins for the market, the pedicels of the berries must be removed. This is called "cap-stemming," and is accomplished by several mechanical devices. Sometimes, particularly during the summer, the cap-stemming is difficult with certain lots of raisins.

Tests were made to determine whether the temperature of the raisins or their degree of dryness accounted for the observed differences.

Two samples of raisins were obtained from a packing house, one of which "cap-stemmed" perfectly and the other very imperfectly. It was found that by chilling the imperfect sample but little improvement could be effected. By slightly drying, however, it could be made equal to the good sample. When dried until it lost 4.5 per cent of its weight, the poor sample "cap-stemmed" as readily as the good sample. This per cent corresponds almost exactly with the difference in moisture contents of the two samples.

Poor sample contained	12.140%	water
Good sample contained	7.379%	water
Difference,	4.761%	

The conclusion seems to be, therefore, that in this case failure to "cap-stem" was due to excess of moisture and indicates that during storage the raisins take up water even in the dry atmosphere of the San Joaquin Valley in summer.

Insects Injurious to Stored Raisins.—Much injury is done to raisins by various insects, principally the Raisin Moth (*Plodia interpunctella* Hüb.) and the Saw-toothed Grain Beetle (*Sylvanus suriramensis* Linn.). The methods of control by screening and fumigation have proved ineffective in many cases.

An investigation was undertaken to attempt to find a more certain way of preventing injury from this cause. The local life history of these insects and the local methods of control in the San Joaquin Valley were carefully observed. The conclusions were that slight changes of the methods in use would insure protection.

The fumigating rooms were in some cases not sufficiently air-tight. The rooms should be very carefully constructed to prevent escape of the gas and should preferably be built of concrete, owing to the inflammable nature of the carbon bisulfid gas employed. Ten pounds of this liquid should be placed in several shallow dishes near the top of the room and the fumigation continued for twenty-four hours.

Improvements in the screening and trapping devices should be made. Raisins passed through the sizing and screening machines are freed from most of the insects, but these insects are usually allowed to escape to reinfest new lots of raisins. This applies especially to the beetles. By modifying the shape of the receptacle which receives the screenings, including insects, all the beetles could be caught and destroyed. The modification consists of an over-lapping removable border furnished with a pad saturated with coal-oil or phenol to prevent the escape of the beetles. At intervals this receptacle is emptied and the insects destroyed.

A study of the life-history of the moth indicates that their numbers can be considerably reduced simply by carefully regulating the time of storage of the raisins in the vineyard and packing house. The plan suggested is: (1) The prevention of the breeding of the insect in the packing house during the winter season, when increase is not liable to occur outside. This is done by bringing the raisins to the house only as fast as needed and of course avoiding the accumulation of anything which might furnish food for the young insects. (2) About the end of April, after a general cleaning-up of the packing house, all remaining raisins in the field are to be brought in to avoid food being there upon which the insect may carry over to the next crop. Thus two or three months of the warmest part of the year without food for the young will cause the race to disappear in the fields and therefore prevent infestation of the new crop in the fall. The seven months in the packing house, during which no raisins will be held long enough to breed out a new generation, should have the same results in that situation.

The adoption of the practice outlined above, taking advantage of the facts in the life histories of these insects, seems a better procedure than to provide abundance of oportunity to increase as is now the rule, requiring expensive treatment with insecticides.

Clarification of Grape Juice.—One of the principal difficulties in the manufacture and preservation of grape juice is to make it perfectly and permanently limpid. Many tests of various methods of defecation, fining, and filtering were made with the following results:

Effect of Defecation.—Defecation gave a clear but not bright liquid before pasteurization, which became cloudy after pasteurization at 185° F. It did not clear perfectly in standing two months after pasteurization, but was in a great deal better condition than the undefecated material.

Juice defecated eleven days before pasteurization became clear before pasteurization, but clouded after heating to 185° F.

Effect of Tannin.—The addition of tannin to defecated and undefecated juice before pasteurization hastened the rate of clearing slightly, but not enough to warrant its use.

Relative Efficiency of Different Fining Materials.—Ten grams isinglass plus 20 grams tannin per hecto, 30 grams isinglass plus 40 grams tannin per hecto, egg albumen 20, 30 and 40 grams per hecto gave rapid clearing of the juice after pasteurization of samples to which the above amounts of fining material were added before heating. Casein gave fair results.

Effect of Filtration before Pasteurization.—Filtration of the defecated and the undefecated juice did not give a clear juice after pasteurization. Filtration with infusorial earth before and after pasteurization did not give a permanently bright juice.

Effect of Fining with Casein at 185° F. followed by Filtration.—Addition of casein finings and heating to 185° F., followed twenty-four hours later by filtration, gave excellent results with Muscat, Furmint, Alicante Bouschet, Alicante Ganzin, and Isabella grape juice.

Separation of Cream of Tartar.—The addition of .2–.4 grams of tartaric acid per 100 cc. gave immediate separation of cream of tartar. Cooling alone did not hasten the separation of the cream of tartar, but cooling after the addition of .1–.4 grams tartaric acid per 100 cc. greatly increased the rate of separation of cream of tartar. Citric acid .1–.2 grams per 100 cc. decreased or prevented the rate of separation of cream of tartar, while the addition of .4 grams citric acid per 100 cc. hastened the rate of separation.

Conclusions.—From the results of these tests it appears that perfect and permanent brightness of grape juice is quickly, surely and easily obtained by the following operations:

1. Defecation for 24–48 hours with 8 to 12 ounces potassium meta-bi-sulfite per ton.
2. Racking of cleared juice; mixing with finings (6 ounces casein or egg albumen per 100 gallons) and heating to 80° C.
3. Addition of .1 per cent to .2 per cent citric acid to the hot juice and allowing to stand at room temperature thirty-six hours.
4. Racking from finings and filtration.
5. Bottling and final pasteurization at 70° to 75° C.

The temperatures mentioned here, while effective for the purpose, are probably unnecessarily high and likely to injure the flavor of the more delicate juices.

Use of Sulfurous Acid and Pure Yeast in Wine-making.—Modern methods of using pure yeasts and sulfurous acid in the fermentation of wine was introduced into many wineries during the last vintage with excellent results. The wines made were examined, analyzed, and compared with wines made by the old methods in the same districts from the same varieties of grapes. The comparison is made in the following tables of wines from a single district.

MICROSCOPICAL EXAMINATION OF WINES

Method of fermentation	No bacteria	A few bacteria	Many bacteria
Ordinary	3	12	34
+ SO_2	10	0	0
+ SO_2 + pure yeast	17	8	0

CHEMICAL EXAMINATION OF WINES

Method of fermentation	No. of wines	Alcohol	Total acid	Vol. acid	Sugar
Red—					
Ordinary	42	12.26	.71	.115	.397
SO_2	1	11.50	.55	.053	.440
SO_2 + pure yeast	24	12.54	.64	.060	.292
White—					
Ordinary	2	11.22	.65	.082	.620
SO_2	6	13.88	.49	.044	.760
SO_2 + pure yeast	3	11.96	.57	.054	.560

The best measure of a clean fermentation—that is a fermentation free from injurious numbers of bacteria—is the lowness of the volatile acid. The superiority of the wines fermented with SO_2 is very marked in this respect. The presence of a large number of injurious bacteria in most of the wines fermented without SO_2 is shown not only by the high volatile acidity, but by direct microscopic examination. The presence of a few bacteria in one-third of the wines fermented with both SO_2 and pure yeast probably indicates simply that owing to the greater clearness of these wines small numbers of bacteria were more easily observed. No wines in practice are completely free from bacteria. The benefits to be obtained from the use of pure yeast are more complete elimination of the sugar, as indicated in the table of analysis and higher quality of flavor and appearance, which were noticeable.

Amounts of Wine and of By-products Yielded by Grapes in a California Winery.—In order to determine the degree of efficiency of our methods of wine-making in utilizing the raw material as accurate an account as practicable was kept of the intake and output of a winery of moderate size. The results are shown in the following tables. These determinations give us some valuable factors for calculating the yields of various products, for planning the character and capacity of various machines, containers, and buildings, and for devising improved methods of more thoroughly utilizing our raw material.

SUGAR CONTENT OF GRAPES CRUSHED (WHOLE VINTAGE)

Pounds of grapes	Max. Bal.	Min. Bal.	Average Bal.
824,157	30.0	17.0	21.875

YIELD OF WINE PER TON OF GRAPES FOR WHOLE VINTAGE

Winery 1—Hydraulic press	177.3 gals.
Winery 2—Continuous press	183.0 gals.

DECREASE OF VOLUME IN CRUSHING

	Max.	Min.	Mean
Volume of fresh grapes in cu. ft. per ton	55.66	47.70	52.43
Volume of crushed grapes in cu. ft. per ton	30.10	21.50	26.47
Decrease in volume in crushing	59.5%	41.39%	49.50%

YIELD OF STEMS

	Max.	Min.	Mean
Laboratory tests	7.04%	3.70%	5.49%
Crusher tests	3.23%	.81%	1.24%

YIELDS PER TON OF WINE, JUICE, POMACE, STEMS, AND LEES

	Max.	Min.	Mean
Stems—pounds	64.6	16.2	27.2
Pomace, unfermented—pounds	513.0	265.0	391.0
Pomace, fermented—pounds	392.1	252.0	345.2
Fresh juice—gallons	183.4	160.4	168.7
White wine—gallons	....	....	151.0
Red wine, free run—gallons	143.0	127.8	136.4
Red wine, press—gallons	43.1	34.7	38.4
Red wine, total gallons	179.5	170.9	174.9
Lees at first racking (red) per cent of wine	5.19	2.10	3.43
Lees at first racking (white), per cent of wine	4.63	2.22	3.62
Cream of tartar in fresh lees—per cent	15.66	3.08	8.06
Cream of tartar in fresh lees in lbs. per ton of grapes.	....	....	4.20

SUGAR BALANCE

	Max.	Min.	Average
Balling degree of grapes	30.00	17.00	21.60
Sugar in grapes—pounds per ton	....	....	418.00
Sugar in stems, per ton of grapes	16.61	5.80	9.74
Alcohol in pomace, per cent	8.00	6.75	7.42
Sugar equivalent in pomace, per ton of grapes	....	....	52.23
Alcohol in red wine, per cent	10.25	12.90	11.88
Sugar equivalent per ton of grapes	....	....	360.06

Sugar in grapes per ton (21.60° B = 20.9% sugar)[†]		418.00 lbs.
Sugar equivalent of wine per ton of grapes	360.06	
Sugar equivalent of pomace per ton of grapes	52.23	
Sugar equivalent of stems per ton of grapes	9.74[*]	
		422.03
Sugar utilized in wine	86.1%	
Sugar lost in pomace	12.5%	
Sugar lost in stems	2.3%	
		100.9%

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[*] Weight of sugar in stems is calculated on laboratory tests which are higher than crusher tests. This probably accounts for the fact that the sugar calculated from the alcohol is 4 lbs. per ton greater than when calculated on the Bal. degree of the grapes.

[†] Calculated from California analyses.

Vinegar-making.—Many complaints have come to the station regarding failures to obtain vinegars of standard strength and quality from apparently good raw material. A considerable amount of work has been done in investigating these troubles, and it appears that imperfect fermentations are the cause of most of them. This is indicated by the following table, which gives the result of fermenting apple juice with sulfurous acid and pure yeast as compared with the spontaneous fermentation usually adopted.

Fermentation I. Spontaneous fermentation in barrel.

Fermentation II. Same apple juice as Fermentation I, but defecated with sulfurous acid and fermented with pure yeast.

After the alcoholic fermentation, the juice was allowed to undergo spontaneous acetic fermentation in the barrel in both cases.

ANALYSES OF NO. I AND NO. II AT VARIOUS TIMES

Sample	Total Acid as Malic	Total Acid as Acetic Per cent	Total Sugar Per cent	Reducing Sugar Per cent	Volatile Acid Per cent	Alcohol Vol. Per cent
Original must	.66	......	15	10.4	......	0
I. Jan. 9, 1913	......	.84	.55	......	......	6.20
II. Jan. 9, 1913	......	.61	.037	......	......	8.00
I. Apr. 5, 1913	......	1.18	.60	......	......	5.6
II. Apr. 5, 1913	......	5.9	......	......	......	2.56

General results of tests No. I and No. II are decidedly in favor of the use of pure yeast and sulfurous acid. SO_2 and pure yeast gave 1.8 per cent more alcohol than natural fermentation; No. I fermented dry while No. II, natural fermentation, stuck with .6 per cent sugar. The natural fermentation developed tourne bacteria; the other did not.

Germination of Olive Seeds.—According to most European authorities, the best olive trees are those grafted on seedling roots. There is some evidence in California corroborating this view. The germination of olive seeds offers some difficulties due to the large proportion of imperfect seeds in some samples and the slowness of germination in all.

Tests were made to determine a practicable method of eliminating the bad seed and of hastening the germination of the good. The proportion of bad seed varied from 0 to 46 per cent in sixteen samples, tested by cracking and examining the kernel.

RATIO OF GOOD SEED TO BAD

	No. of seed	Good seed Per cent	Bad seed Per cent
1. Seeds from seeding, University Campus	550	60.5	39.5
2. Seeds from Razzo variety, University Campus	250	54.0	46.0
3. Oblonga, Corning	27	74.0	26.0
4. Medium sized olive, Corning	24	96.0	4.0
5. Smal sized olive, Corning	61	91.8	8.2
6. Redding, Davis	100	99.0	1.0
7. Redding, Fresno	709	85.2	14.8
8. Columella, Niles	100	79.0	21.0
9. Polymorpha, Niles	50	78.0	22.0
10. Regalis, Niles	50	66.0	34.0
11. Pendulina, Niles	50	100.0	0
12. Atro-Rubens, Niles	50	80.0	20.0
13. Rubra, Niles	40	85.0	15.0
14. Picholine d'Aix, Niles	36	86.1	13.9
15. Mission, Davis	38	89.5	10.5
16. Mission, Davis (1914)	100	86.0	14.0

Percentage of Good seed—Maximum 100%, Minimum 54%, Average 81.9%

The bad seeds are of lighter specific gravity than the good, and it was found possible to separate them by floating in a salt solution. Where a solution of suitable concentration was used, an average of 97 per cent of the good seed sank to the bottom. When the seeds which floated in such solutions were removed, of those remaining, 95 per cent were good.

The best concentration of the salt solution depends on the condition of the seeds. Seeds freshly separated from the pulp gave the best separation in a solution containing 25 parts of salt to 100 parts of water by weight. Dried seeds gave the best separation in a 10 per cent solution. In a stronger solution a considerable portion of the good seed floated and was lost. After soaking dried seeds for two days in water, a satisfactory separation was obtained as with fresh seed in a 25 per cent solution. After soaking for fifteen days, the poor seed became almost as heavy as the good and a satisfactory separation by this means was found impossible.

Separation of Good Seed from Bad Seed

(By difference of specific gravity as shown by floating or sinking in various solutions)

A. Fresh Seed—

1. *In water.*

Seedling, U. C. campus: No. of seed 1000, No. floating 7. All seeds that floated were bad. Examination of kernels showed 39.5 per cent of total number of seeds were bad. Water alone is useless for separation.

2. *In 25 per cent brine.*

	No. of seed used	No. that sank		No. that floated		Per cent of good seed retained	Per cent good in seed retained
		Good	Bad	Good	Bad		
Seedling on U. C. campus	100	58	8	....	34	100	87.5
Razzo on U. C. campus	50	27	2	....	21	100	93
Oblonga, Corning	27	20	2	....	5	100	90.9
Medium sized olive, Corning	24	23	1	....	....	100	96
Small sized olive, Corning	61	56	1	....	4	100	92
Redding, Davis	50	49	1	....	....	100	98
Columella, Niles	100	78	2	1	19	98.73	97.5
Polymorpha, Niles	50	39	1	....	10	100	97.5
Regalis, Niles	50	33	2	....	15	100	94
Pedulina, Niles	50	47	....	3	....	94	100
Atro-Rubens, Niles	50	40	3	....	7	100	93
Rubra, Niles	40	33	1	1	5	94	94
Picholine d'Aix, Niles	36	31	....	....	5	100	100

Good kernels in seed before separation	78.33%
Good kernels in seed after separation	96.51%
Good kernels lost in separation	.92%

B. Dry Seeds—

1. *Before soaking.*

No. days dried	Variety and locality	Per cent solution	No. seed used	No. that sank		No. that floated		Per cent of good seed retained	Per cent good in seed retained
				Good	Bad	Good	Bad		
2	Seedling, U.C. grounds	25	50	25	1	5	19	83.3	96.1
2	Razzo, U.C. grounds	25	50	14	....	12	24	53.8	100.0
2	Razzo, U.C. grounds	10	50	25	1	4	20	89.65	96.2
12	Razzo, U.C. grounds	10	50	23	2	3	32	88.45	99.0
12	Seedling, U.C. grounds	10	50	30	3	....	17	100.00	90.9

After drying two days, a 25 per cent salt solution not satisfactory because of the loss of good seed. After drying from two to twelve days, a 10 per cent salt solution proved satisfactory.

2. *After soaking.* (Seeds dried 20 days.)

No. days soaked	Variety and locality	Per cent solution	No. seed used	No. that sank Good	No. that sank Bad	No. that floated Good	No. that floated Bad	Per cent of good seed retained	Per cent good in seed retained
2	Seedling, U.C. grounds	15	50	35	12	....	3	100.0	74.5
2	Seedling, U.C. grounds	25	50	29	1	3	18	90.6	96.7
2	Razzo, U.C. grounds....	25	50	25	1	2	22	92.6	96.2
15	Seedling, U.C. grounds	25	50	31	19	....	....	100.0	*62.0
15	Seedling, U.C. grounds	30	50	27	23	....	....	100.0	54.0
15	Seedling, U.C. grounds	35	50	29	21	....	....	100.0	58.0
15	Seedling, U.C. grounds	40	50	32	13	....	5	100.0	71.1
15	Seedling, U.C. grounds	45	50	34	9	....	7	100.0	79.1
15	Redding, Davis	25	50	50	....	....	....	100.0	100.0

* These seeds were not perfectly mature.

After soaking dry seeds two days, a 15 per cent salt solution is not satisfactory, but a 25 per cent salt solution gives satisfactory results. After long continued soaking the poor seed seems as heavy as good seed, and a satisfactory separation cannot be made, even with a saturated salt solution.

If planted without treatment, even good seed is very slow in germinating, most usually requiring a year or more. Various methods of preliminary treatment were tested with the results given in the table on page 198.

Bitter Principles of Olives.—The preparation of olives, either green or ripe, for food consists essentially of the removal of the bitterness. Salt is added partly to improve the flavor and partly as a preservative. When olives are canned or bottled, the latter purpose is unnecessary.

The removal of the bitterness is accomplished by prolonged soaking in water, by treatment with a caustic alkali or, usually, by a combination of both. The exact nature of all the substances to which the bitterness is due does not seem to be well understood, nor the effect on the principles of the various operations of pickling. A series of tests and observations was made to throw light on these points with the following results:

1. *Bitterness and Acidity.*—According to Power and Tutin, the bitter substances are not acids and none of the acids are bitter. Neutralization of the acidity, therefore, does not remove the bitterness.

2. *Solubility of the Bitter Substances.*
   - (*a*) Soluble in water.
   - (*b*) Soluble in hot alcohol.
   - (*c*) Soluble in chloroform.
   - (*d*) Slightly soluble in ether.

Light seeds eliminated by separation in 25 per cent salt solution. Heavy seeds planted in 10-inch propagating flats in soil composed of three parts sand one part garden mulch. Flats were filled to within 1 inch of top, seeds were put in, ½ inch more soil added, the whole well firmed. Care was taken to keep ground moist at all times.

	Kinds of							
	Seedlings on U. C. Grounds				Redding, Davis			
List of Tests made	No. of seed used	No. of seed sprouting June 20	No. of seed sprouting Aug. 8	Per cent of seed sprouting	No. of seed used	No. of seed sprouting Jun. 20	No. of seed sprouting Aug. 8	Per cent of seed sprouting
1. Soaked in water 15 days, apex cut	250	98	121	48.4	250	166	221	88.4
2. Soaked in water 15 days, base cut	250	59	110	44.0	250	84	200	80.0
3. Dry seed, apex cut	125	46	55	44.0	......	......	......	......
4. Dry seed, notch filed near base	50	6	18	36.0	......	......	......	......
5. Dry seed, base cut	150	39	40	*26.6	......	......	......	......
6. Dry seed, soaked 1 hr. in 10% solution H_2SO_4	200	23	48	24.0	......	......	......	......
7. Dry seed, soaked 16 hrs. in 10% potash solution	100	2	21	21.0	......	......	......	......
8. Dry seed, untreated	250	11	45	18.0	......	......	......	......
9. Soaked in water 15 days	2075	62	350	17.3	200	17	60	30.0
10. Soaked 30 min. in full strength H_2SO_4	300	13	27	13.5	......	......	......	......
11. Soaked in lime paste 42 hrs.	50	0	5	10.0	......	......	......	......
12. Soaked in 10% potash solution 8 hrs.	100	4	†	......	......	......	......	......
13. Planted with pulp on	100	0	0	0	......	......	......	......

* Some lost by damping off. † Whole flat disappeared.

Conclusions—

1. Cutting off apex the most effective aid to germination.
2. Soaking in water for 15 days useless.
3. Soaking in solution of 10 per cent potash or sulfuric acid of litle use.
4. Soaking in strong sulfuric 30 minutes and in lime paste 42 hours apparently injurious.
5. Seeds of naturally poor germinating powers. (Exp. 1–4, Berkeley seedling) gave better results when the apex was cut than seeds of good germinating power (Exp. 9, Redding from Davis) when untreated.
6. When planted with the pulp, the germination is very slow, none starting within five months.

3. *Location of Bitterness in the Olives.*—In crushing olives, much of the bitterness is found dissolved in the juice; much remains in the pulp.

4. *Destruction of Bitterness.*
   A. Bitterness is not destroyed by:
      (*a*) Exact neutralization.
      (*b*) Slight excess lye.
      (*c*) Exact neutralization and heating under 15 lbs. pressure 1 hr.
      (*d*) Slight excess HC and heating under pressure.
      (*e*) Heating untreated juice under pressure.
      (*f*) Excess $NaHCO_3$ (sodium bicarbonate).
      (*g*) Yeast fermentation.
   B. Bitterness is destroyed by:
      (*a*) Considerable excess NaOH.
      (*b*) Considerable excess Na_2CO_3.
      (c) Slight excess alkali and heating under pressure.

5. *Tests on Juice.*
   (*a*) Addition of 2 per cent KOH destroys bitterness immediately.
   (*b*) Neutralization and addition of .7 per cent excess KOH destroyed bitterness in 24 hrs.
   (*c*) Addition of an excess of .56 per cent had little effect.

These tests indicate that there are several factors at work in the removal of bitterness by the ordinary methods used by picklers.

The bitter principles are freely soluble in water, but it requires prolonged soaking for several weeks or months in frequent changes of water to remove them. The length of time necessary is due to the resistance of the tissues of the olive to the passage of water. This resistance may be diminished by treatment with caustic potash or soda and the time of removal much shortened. Alkalis not only facilitate the extractive action of water, but if used to a certain excess, actually destroy the bitterness by hydrolyzing the bitter principles of which the principle appears to be the glucoside *Oleuropein.*

Softening of Olives.—Certain varieties of olives, and all when overripe, tend to become soft during the pickling processes, especially in the lye solutions. Salt may be used in conjunction with the lye to counteract this softening effect. Tests were made to determine the most favorable amount of salt to use as follows:

1133 ripe Mission olives from Davis.
   (*a*) 1½% KOH (witness).
   (*b*) 1½% KOH + 1% NaCl.
   (*c*) 1½% KOH + 3% NaCl.
   (*d*) 3% KOH + 3% NaCl. Put olives in on Dec. 5, P.M.
   (*e*) 1½% KOH + 5% NaCl.
   (*f*) 1½% KOH + 10% NaCl.

Dec. 6, '13, P.M. (approximately 24 hours later)—
   3%, 5%, 10% NaCl made olives firm and leathery; 1% not very effective.

If too little salt is used it has little effect; if too much, it delays the action of the lye. About 3 per cent of salt appears to be suitable and sufficient even with strong lye solutions.

Olive Paste.—Certain varieties of olives are too small to satisfy the popular demand for a large pickle. A certain proportion, sometimes considerable, even of the largest varieties, are too small for the same purpose. These small fruits are used for the manufacture of oil, but their value for this purpose is small. When pickled they are excellent to eat, equallying or exceeding the large olives in flavor.

More or less successful attempts were made to use these small olives and also over-ripe, frost-bitten, and bruised olives for the preparation of an olive paste, which could be used in the same way as the various meat pastes commonly found on the market. It was found possible to remove the pits of the fresh olives, grind up the pulp, remove the bitterness, salt to taste, and thus produce an olive paste that was relished by everyone to whom it was submitted and usually pronounced better than any meat paste and even better than the best ripe pickled olives.

The processes tested were rapid, requiring from forty-eight to less than five hours. It is probable that a process could be devised which would be continuous.

The main defects of this method of utilizing olives are the comparatively small amount of paste yielded by a given weight of olives. The removal of the pits removes from 15 to 30 per cent of the volume of the fruit. The processes used in making the paste cause a further diminution of weight of about one-third. Some of this last loss could very probably be avoided by improved methods of handling.

With the methods used, a ton of small olives would yield on the average about 1000 pounds of olive paste. As the process of manufacture is simple and inexpensive, even this yield should be more profitable than oil-making if the public would be willing to pay as much for olive paste as for meat pastes.

Sizing of Pickled Olives.—Olives to be used for pickling are always passed through a *grader* or *sizer,* which segregates the various sizes. This is necessary, both because olives of different sizes are difficult to pickle properly if mixed and because the larger sizes are much more valuable. The sizing is done with varying degrees of exactness, according to the ideas of the pickler and the type of machine in use.

Determinations of the sizes, i.e., average diameters and corresponding number of olives per pound, was made on a number of commercial samples of pickled olives.

The size is defined by the limits of the short diameter of the fruit in sixteenths of an inch. Four sizes of pickling olives are usually recognized: Size 1, over 16 sixteenths; size 2, from 14 to 15 sixteenths; size 3, from 12 to 13 sixteenths, and size 4, from 10 to 11 sixteenths. Olives under 10 sixteenths of an inch are usually not pickled. The variations in each size differ very much with different brands of olives. The differences depend probably on the kind of sizing machine employed. The following tables gives the results of some measurements made:

AVERAGE DIAMETERS AND NUMBERS PER POUND OF VARIOUS SAMPLES OF PICKLED OLIVES

Sizes	1		2		3		4		5	
Samples	D	N	D	N	D	N	D	N	D	N
1 to 4	16.05	36	13.63	59	11.89	84	11.57	103	9.95	127
5 to 8	....	....	13.70	62	11.98	88	....	....	9.98	157
9 to 11	....	....	13.30	65	12.69	74	11.35	96	....	......
12 to 14	....	....	13.60	62	13.25	68	12.59	76	....	......
Means	16.	36	13.56	62	12.45	78	11.83		9.96	142

ESTIMATED AVERAGE NUMBER PER POUND OF VARIOUS SIZES

D =	16	15	14	13	12	11	10
N =	36	45	57	70	85	112	140

Usual grades =	No. 1	No. 2	No. 3	No. 4
N =	36	51	78	126
D =	16	14.5	12.5	10.5

D = average diameter (short) of olives in sixteenths of an inch.

N = number of olives per pound.

DEPARTMENT LIBRARY

BY

MRS D. L. BUNNELL

History.—Since the burning of the old Agricultural Building, seventeen years ago, efforts have been made from time to time to replace the collection of publications issued by the United States and the various state institutions and societies. This collection was first taken care of in the Director's Office. When, however, in 1907, the Director's Office was moved, the room was given over entirely to the collection of agricultural publications and accumulation of agricultural books, and a stenographer placed in charge, who devoted as much time as possible to the library work. In this way, some assistance was secured in holding the collection together, but the work was too spasmodic and unsystematic to make much headway. In our new Agriculture Hall, a larger room was assigned to the Library, and since July 1st an effort has been made by the Librarian (appointed at that time), to make the valuable material available to both instructors and students.

In order to ascertain the extent to which the department library is used by readers, records were kept for three months, with the following result:

	February	March	April
Students and others	1,478	1,466	1,579
Instructors	149	116	129

Accessions.—The number of books added to the library are as follows:

	Volumes
Purchases	525
Gifts	1,007
Total	1,532
Periodicals and serials bound	1,034
Total	2,566

In addition to the above accessioned books many hundred pamphlets have been received through the medium of exchange, and on request, to complete files.

Binding.—The number of books and periodicals bound during the year was 1034. The funds allotted to the library were insufficient to bind five hundred more complete volumes, consisting of annual reports, proceedings of societies, and publications of various state institutions; also many foreign serials. The arrears in binding were the accumulation of many years' standing, caused by lack of money for labor and binding.

Periodicals.—The current periodicals received during the year number:

Domestic	202
Foreign	58
Total	260

Since July 1st, forty-six new titles (domestic) have been added, and thirty-five have discontinued or ceased publication.

The total number of periodicals received is as follows:

By gift and exchange	269
Purchased	21
Total	290

Duplicates.—Duplicates of government, state and society publications were received, sent in some cases to us and in others sent to the library by the staff. These duplicates have been placed in chronological order in the basement, and will be used to assist in completing an extra set of publications which we are getting together for the use of students; also to complete the files of the University Farm and Citrus Experiment Station. The balance, so far as possible, will be used for exchange.

We also receive duplicate copies of the following periodicals, which are sent to the Main Library for file in the Periodical Room:

American Fertilizer.
Better Farming.
Better Fruit.
Breeder and Sportsman.
Breeder's Gazette.
California Cultivator.
California Fruit Grower.
California Garden.
Chicago Dairy Produce.
Farm and Fireside.
Farmers' Review.
Field and Farm.
Hay, Flour and Feed Journal.
Hoard's Dairyman.
Jersey Bulletin and Dairy World.
Kansas Farmer.
Live Stock and Dairy Journal.
Louisiana Planter.
Ohio Farmer.
Orange Judd Farmer.
Oregon Agriculturist.
Pacific Fruit World.

Pacific Poultrycraft.
Petaluma Poultry Journal.
Practical Dairyman.
Progressive Farmer.
Vegetable Grower.
White Breeder's Companion.
Wallace's Farmer.

Other periodicals which are sent to the Periodical Room, Main Library, are:

American Journal of Veterinary Medicine.
Jahresbericht über die leistungen auf den Gebiete des Veterinaire Medizin.
Monatshefte für praktische Tierheilkunde.
Münchener tierärztliche wochenschrift.
Oesterreichische Wochenschrift für Tierheilkunde.
Recueil de Medecine Veterinaire.
Schweizer Archiv. für Tierheilkunde.
The Veterinary News.
Veterinary Record.
Zeitschrift für Fleisch und Milch Hygiene.
Zeitschrift für Infektion Krankheiten der Haustiere.
Zeitschrift für Tiermedizin.
Zeitschrift für Tuberkulose.

Inventory.—An incomplete inventory shows the number of bound volumes to be 5515.

The above does not include the books at the University Farm and Citrus Experiment Station, as records have not yet been completed; nor does it include books on agricultural subjects in the Main Library.

Cataloguing.—Very little has been done in the way of cataloguing, aside from this year's accessions.

We have secured the standard size Dictionary Catalogue of the United States publications, exchanging the smaller 2 × 5 cards, which were used some years ago. We are also beginning to check over the catalogue of station publications to ascertain whether in the past all the cards published have been included.

A list of periodicals received on the basis of exchange:

American Bee Journal	Hamilton, Ill.
American Breeder	Kansas City, Mo.
American Brewers' Review	Chicago, Ill.
American Cultivator	Boston, Mass.
American Farming	Chicago, Ill.
American Fertilizer	Philadelphia, Pa.
American Florist	Chicago, Ill.
American Hay, Flour and Feed Journal	New York
American Hereford Journal	Kansas City, Mo.
American Miller	Chicago, Ill.

American Poultry Advocate	Syracuse, N. Y.
American Poultry Journal	Chicago, Ill.
American Sheep Breeder and Woolgrower	Chicago, Ill.
American Wine Press	San Francisco, Calif.
Arkansas Farmer and Homestead	Little Rock, Ark.
Argonaut	San Francisco, Calif.
Australasian	Melbourne, Australia
Banker-Farmer	Champaign, Ill.
Bendigonian	Victoria, B. C.
Berkshire World and Corn Belt Stockman	Springfield, Ill.
Better Farming	Chicago, Ill.
Better Fruit	Hood River, Ore.
Breeder and Sportsman	San Francisco, Calif.
Breeder's Gazette	Chicago, Ill.
Bonforts' Wine and Spirit Circular	New York
Business Farmer	Tropico, Calif.
Butchers' and Stockmen's Journal	San Francisco, Calif.
California Cultivator	San Francisco, Calif.
California Farmer	San Jose, Calif.
California Fruit Grower	San Francisco, Calif.
California Garden	Point Loma, Calif.
California Grange	Mountain View, Calif.
California Real Estate	Berkeley, Calif.
Campbell's Scientific Farmer	Lincoln, Nebraska
Canadian Countryman	Toronto, Canada
Canner, The	Chicago, Ill.
Carlson's Rural Review	Northfork, Neb.
Caterpillar Times	Stockton, Calif.
Chicago Dairy Produce	Chicago, Ill.
Circle and Success Magazine	New York
Coast Seaman's Journal	San Francisco, Calif.
Cockerel, The	Browns Mills, N. J.
Coleman's Rural World	St. Louis, Mo.
Commercial Fertilizer	Atlanta, Ga.
Connecticut Farmer	New Haven, Conn.
Corn	Waterloo, Ia.
Country Gentleman	Philadelphia, Pa.
Creamery and Milk Plant Monthly	Chicago, Ill.
Creamery Journal	Waterloo, Ia.
DuPont Magazine	Wilmington, Del.
El Commercio	New York
Elgin Dairy Report	Elgin, Ill.
Farm Engineering	Springfield, Ohio
Farm Journal	Philadelphia, Pa.
Farm Life and Agricultural Epitomist	Chicago, Ill.
Farm News	Springfield, Ohio
Farm Poultry	Boston, Mass.
Farm Progress	St. Louis, Mo.
Farm Stock and Home	Minneapolis, Minn.
Farm and Fireside	Springfield, Ohio

Farm and Home	Springfield, Mass.
Farm and Orchard	Keyser, West Va.
Farm and Ranch	Dallas, Tex.
Farmer, The	St. Paul, Minn.
Farmer, The	Lincoln, Neb.
Farmer and Stockman	Des Moines, Ia.
Farmers' Digest	Columbia, Pa.
Farmers' Advocate	London, Ontario
Farmers' Boy	Exeter, Calif.
Farmers' Guide	Huntington, Ind.
Farmers' Voice	Chicago, Ill.
Farmers' Weekly	Bloemfontein, South Africa
Farmers' Wife	St. Paul, Minn.
Feathered World	Strand, London
Field, The	New York
Field and Farm	Denver, Colo.
Florida Grower	Tampa, Fla.
Florists Review	Chicago, Ill.
Flour and Feed	Milwaukee, Wis.
Fruit Grower and Farmer	St. Joseph, Mo.
Fruitman and Gardener	Mount Vernon, Ia.
Fruit and Produce Distributor	Portland, Ore.
Furrow, The	Moline, Ill.
Garden, The	London, Eng.
Garden Magazine	New York
Gardeners' Chronicle	New York
Gas Power	St. Joseph, Mich.
Gentlewoman, The	New York
Gleanings in Bee Culture	Medina, Ohio
Greens Fruit Grower	Rochester, N. Y.
Grizzly Bear	Los Angeles, Calif.
Grocer, The	San Francisco, Calif.
Good Poultry	Saugatuck, Mich.
Harvester World	Chicago, Ill.
Hawaiian Forester and Agriculturist	Honolulu, T. H.
Hoard's Dairyman	Fort Atkinson, Wis.
Holstein Friesian Register	Battleboro, Vt.
Home and Farm	Louisville, Ky.
Hospodar	Omaha, Neb.
Hospodarske Listy	Chicago, Ill.
Indiana Farmer	Indianapolis, Ind.
Iowa Homestead	Des Moines, Ia.
Irrigation Age	Chicago, Ill.
Irrigation Record	Leeton, N. S. W.
Jersey Bulletin and Dairy World	Indianapolis, Ind.
Jewish Farmer	New York
Journal of Heredity	Washington, D. C.
Kansas Farmer	Topeka, Kansas
Kimball's Dairy Farmer	Waterloo, Ia.
La Hacienda	Buffalo, N. Y.

Lewiston Orchard's Life	Lewiston, Idaho
Live Stock and Dairy Journal	Sacramento, Calif.
Louisiana Planter	New Orleans, La.
Maritime Farmer	Sussex, N. B.
Mark Lane Express	London, Eng.
Market Growers Journal	Louisville, Ky.
Market Letter	Portland, Ore.
Michigan Farmer	Detroit, Mich.
Milk Trade Journal	Waterloo, Iowa
Miller, The	London, Eng.
Missouri Farmer	Columbia, Mo.
Missouri and Kansas Farmer	Kansas City, Mo.
Modern Miller	St. Louis, Mo.
Motoring Magazine and Motor Life	San Francisco, Calif.
National Farmer	Bay City, Mich.
National Farmer	Winona, Minn.
National Farmer and Stockgrower	St. Louis, Mo.
National Provisioner	New York
National Stockman and Farmer	Pittsburg, Pa.
National Wool Grower	Salt Lake City, Utah
Northwest Farm and Home	North Yakima, Wash.
Nebraska Farm Journal	Omaha, Neb.
Northwest Horticulturist	Tacoma, Wash.
Nut Grower	Waycross, Ga.
Ohio Farmer	Cleveland, Ohio
Oklahoma Farm Journal	Oklahoma City, Okla.
Orange Judd Farmer	Chicago, Ill.
Orchard and Farm	San Francisco, Calif.
Oregon Agriculturist	Portland, Ore.
Out West	Los Angeles, Calif.
Overland Monthly	San Francisco, Calif.
Pacific Dairyman	Seattle, Wash.
Pacific Dairy Review	San Francisco, Calif.
Pacific Fruit World	Los Angeles, Calif.
Pacific Garden	Pasadena, Calif.
Pacific Homestead	Salem, Ore.
Pacific Poultrycraft	Monrovia, Calif.
Pacific Rural Press	San Francisco, Calif.
Pacific Service Magazine	San Francisco, Calif.
Pacific Wine, Brewing, and Spirit Review	San Francisco, Calif.
Park and Cemetery	Chicago, Ill.
Pennsylvania Farmer	Philadelphia, Pa.
Petaluma Poultry Journal	Petaluma, Calif.
Poultry Husbandry	Waterville, N. Y.
Poultry Life	Portland, Ore.
Practical Dairyman	Syracuse, N. Y.
Practical Farmer	Philadelphia, Pa.
Prairie Farmer	Chicago, Ill.
Progressive Farmer	Dallas, Texas
Progressive Farmer and Southern Farm Gazette	Raleigh, N. C.

Pure Products	New York
Queenslander, The	Brisbane, Australia
Refrigerating World	New York City
Reliable Poultry Journal	Quincy, Ill.
Roeding's Practical Horticulturist	Fresno, Calif.
Rumely Power, Seed and Soil	La Porte, Ind.
Rural Californian	Los Angeles, Calif.
Rural Home	New York
Rural New Yorker	New York
Rural Spirit	Portland, Ore.
San Francisco News Letter	San Francisco, Calif.
San Joaquin Light and Power Magazine	Fresno, Cal.
Scientific American	New York
Signs of the Times	Mountain View, Calif.
Southern Agriculturist	Nashville, Tenn.
Southern Fruit Grower	Chattanooga, Tenn.
Southern Planter	Richmond, Va.
Southwest Trail	Chicago, Ill.
Southwestern Stockman and Farmer	Phoenix, Ariz.
Standard Oil Bulletin	San Francisco, Calif.
Star, The	San Francisco, Calif.
State Journal	Raleigh, N. C.
Suburban Life	New York
Successful Farming	Des Moines, Iowa
Successful Poultry Journal	Chicago, Ill.
Sugar	Chicago, Ill.
Sunset Magazine	San Francisco, Calif.
Texas Farm and Fireside	Houston, Texas
Texas Stockman and Farmer	San Antonio, Texas
Threshermen's Review and Power Farming	St. Joseph, Mo.
Town Talk	San Francisco, Calif.
Trade, The	Baltimore, Md
Utah Farmer	Lehi, Utah
Valley Farmer	Brownsville, Texas
Vegetable Grower	Chicago, Ill.
Wallace's Farmer	Des Moines, Iowa
Wasp, The	San Francisco, Calif.
Western Canner and Packer	San Francisco, Calif.
Western Empire	Minneapolis, Minn.
Western Honey Bee	Covina, Calif.
Western Journal of Education	San Francisco, Calif.
Western Poultry Review	Hayward, Calif.
Western Stock Journal	Oregon City, Ore.
White Breeders' Companion	Rochester, Ind.
Wholesalers' and Retailers' Review	San Francisco, Calif.
Wisconsin Agriculturist	Racine, Wis.

Newspapers.—One hundred and six newspapers are received in exchange for the publications of this station:

Amador Record, Sutter Creek.
Anaconda Standard, Anaconda, Mont.
Anaheim Gazette, Anaheim.
Benicia Herald, Benicia.
Bien, San Francisco and Oakland.
Bismarck Weekly Tribune, North Dakota.
Blue Lakes Advocate, Blue Lake.
Brawley News, Brawley.
Byron Times, Byron.
California Demokrat, San Francisco.
California Zeitung, San Jose.
Chandler Arizonian, Chandler, Ariz.
Chicago Daily Farmers and Drovers
Chicago Live Stock World.
Cincinnati Weekly Enquirer.
Corning New Era, Corning.
Daily Drovers Journal-Stockman, So. Omaha, Nebraska.
Daily Journal of Commerce, San Francisco.
Daily Outlook, Santa Monica.
Davis Enterprise, Davis.
Denni Hlasatel, Chicago.
Deutsche Zeitung, San Diego.
Dinuba Sentinel, Dinuba.
Dispatch Democrat, Ukiah City.
Evening Tribune, San Diego.
Florida Times Union, The, Jacksonville, Florida.
Fowler Ensign, Fowler.
Fresno Herald, Fresno.
Gateway Gazette, The, Beaumont.
Georgetown Gazette, Georgetown.
Gilroy Advocate, Gilroy.
Glenn Transcript, The, Willows.
Hayward Twice-a-Week Review.
Healdsburg Enterprise, The, Healdsburg.
Healdsburg Tribune, Healdsburg.
Humboldt Times, Eureka.
Independent, The, San Rafael.
Inyo Register, Bishop.
Ione Valley Echo, Ione.
Lake County Bee, Lakeport.
Ledger, The, Reedley.
Lincoln Freie Presse, Lincoln, Neb.
L'Italia, San Francisco.
L'Union Nouvelle, Los Angeles.
Livermore Echo, Livermore.
Madera Mercury, Madera.
Mail of Woodland, The, Woodland.
Mendocino Beacon, Mendocino.
Merced County Sun, Merced.
Merced Express, Merced.
Merced Star, Merced.
Modesto Evening News, Modesto.
Monitor, The, San Francisco.
Mountain Realty, The, Skyland.
Mountain View Register-Leader.
Napa Register, The, Napa.
Napa Weekly Journal, Napa.
Nord-California Herold, Sacramento.
North Fort Worth Sunday News, Fort Worth, Texas.
New Hampshire Farmer, Manchester, N. H.
O'Aranto, Oakland (Portuguese).
Oakland Enquirer, Oakland.
Oakland Journal, Oakland.
Oceanside Blade, The, Oceanside.
Orange Post, The, Orange.
Oshawa Vindicator, Oshawa, Ontario.
Oxnard Courier, Oxnard.
Pasadena Star, The, Pasadena.
Paso Robles Record, The, Paso Robles.
Pleasanton Times, The, Pleasanton.
Point Arena Record, Point Arena.
Porterville Daily Record, Porterville.
Red Bluff Daily News, Red Bluff.
Redlands Review, The, Redlands.
Reno Evening Gazette, Reno, Nev.
River News, The, Rio Vista.
Riverbank Review, Riverbank.
Riverside Daily Press, Riverside.
Saint Helena Star, St. Helena.
Salinas Weekly Index, Salinas.
Salinas Weekly Journal, Salinas.
San Jose Mercury-Herald, San Jose.
San Jose Times-Star, San Jose.
Santa Ana Bulletin, Santa Ana.
Saturday Press, Oakland.
Selma Irrigator, Selma.

Semi-Weekly Farm News, The, Galveston, Texas.
Solano County Courier, Suisun.
Spokesman Review, The, Spokane, Wash.
Sun, The, Colusa, Colusa.
Times, The, State College, Pennsylvania.
Times-Gazette, Redwood City, Redwood City.
Tulare County Times, Visalia, Tulare.
Turlock Journal, Turlock.
Vacaville Reporter, Vacaville.
Ventura Free Press, Ventura.
Ventura Weekly Democrat, The, Ventura.
Watsonville Register, Watsonville.
Weekly Capital City News and Western Farmers Review, Boise City, Idaho.
Weekly Chronicle, The, San Francisco.
Weekly Tulare Register, Tulare.
Yreka Journal, Yreka.

Gifts.—Early in the year, a circular letter was sent to the newspapers of the State, and personal letters written to various agricultural pioneers and others, in the hope of securing old and "out of print" publications (especially Californian) for our library. Letters were also written to various institutions and societies, with the following result:

Donor	Bound volumes	Unbound publications
Adler, D., Windsor, Calif.	....	190
Alabama State Highway Commission, Montgomery, Ala.	....	3
American Automobile Assn., Washington, D. C.	....	2
American National Live Stock Assn., Denver, Colo.	13	.. .
American Pomological Society, Michigan	....	3
American Portland Cement Manufacturers, Philadelphia, Pa.	....	11
Bade, W. F., Berkeley, Calif.	....	3
Bearss, J. T., Fresno, Calif.	....	750
British Columbia, Deputy Minister of Agriculture	....	53
British Columbia, Department of Agriculture	....	4
Boyd, Jas., Riverside, Calif.	2	1
Burnett, P. H. (Lehigh Valley R. R. Co.), N. Y.	....	5
California Development Board, San Francisco, Calif.	8	....
California State Engineer's Office, Sacramento, Calif.	....	3
Chamber of Commerce, Fresno, Calif.	16	17
Chico Public Library, Chico, Calif.	6	....
Colorado State Board of Horticulture, Denver, Colo.	10	....
Colorado State College of Agriculture, Fort Collins, Colo.	2	3
Colorado State Engineer's Office, Denver, Colo.	2	....
Condit, I. J., University of California	3	....
Conkey, G. E. Co., Cleveland, Ohio	....	2
Cyphers Incubator Co., Oakland, Calif.	....	8
de Rekowski, Chas. W., Detroit, Mich.	....	4
Delaware State Board of Agriculture, Dover, Delaware	24	....
Dore, John S., Fresno, Calif.	77	639
Emerson, H. D., Jackson, Calif.	5	4
Ferguson, A. M., Sherman, Texas	1	....
Florida Commissioner of Agriculture, Tallahassee, Fla.	1	5

Donor	Bound volumes	Unbound publications
Franceschi, C. F., Santa Barbara, Calif.	....	10
Friselle, S. P., Fresno, Calif.	11	14
German Kali Works, San Francisco, Calif.	....	15
Georgia Commissioner of Horticulture, Atlanta, Ga.	....	6
Georgia State Horticultural Society, Athens, Ga.	3	....
Gilmore, J. W., University of California	....	2,250
Harper, T. E., Corning, Calif.	6	28
Housing Commission, Los Angeles, Calif.	....	4
Hilgard, E. W., University of California	9	592
Hunt, T. Forsyth, University of California	10	38
Idaho State Engineer's Office, Boise City, Idaho	....	2
Illinois Farmers' Institute, Springfield, Ill.	13	10
Illinois State Agricultural Society, Urbana, Ill.	12	....
Illinois State Bee-Keepers' Assn., Springfield, Ill.	8	4
Illinois State Board of Horticulture, Normal, Ill.	16	....
Illinois State Food Commissioner, Carbondale, Ill.	10	....
Indiana State Board of Forestry, Indianapolis, Ind.	3	2
Indiana State Library, Indianapolis, Ind.	16	....
John Crerar Library, Chicago, Ill.	....	18
Kentucky Geological Survey, Frankfort, Ky.	....	3
Knowland, J. R., Washington, D. C.	12	....
Kruckeberg, H. W., Los Angeles, Calif.	....	2
Library of Congress, Copyright Deposits	19	38
Library of Congress, Washington, D. C.	90	103
London Board of Agriculture and Fisheries, London	....	135
Locke, Miss, Santa Cruz, Calif.	....	92
Louisiana State Engineer's Office, New Orleans, La.	....	12
Massachusetts State Board of Agriculture, Boston, Mass.	17	13
Maryland Board of Park Commissioners, Baltimore, Md.	1	....
Maryland Commissioner of Health, Baltimore, Md.	....	3
Maryland State Roads Commission, Baltimore, Md.	1	7
Macmillan Company, San Francisco, Calif.	1	....
Main State Highway Commission, Augusta, Me.	6	1
Maine Forest Commissioner, Augusta, Me.	....	3
Maine State Board of Agriculture, Augusta, Me.	37	....
Maine State Library, Augusta, Me.	4	....
Maillard, J., San Francisco, Calif.	33	46
Minnesota State Dairy and Food Commission, Minneapolis, Minn.	6	1
Minnesota State Engineer's Office, Minneapolis, Minn.	6	1
Minnesota Farmers' Institute, Minneapolis, Minn.	5	....
Minnesota Bureau of Commerce and Labor, St. Paul, Minn.	3	3
Minnesota State Agricultural Society, Hamlin, Minn.	2	2
Michigan State Highway Dept., Lansing, Mich.	2	2
Michigan Forestry Commission, Lansing, Mich.	4	4
Meadowbrook Farm, Allendale, N. J.	....	1
Montana State Engineer's Office, Helena, Mont.	....	3
Montana Farmers' Institute, Bozeman, Mont.	5	1
Melon Institute of Industrial Research, Pennsylvania	....	5

Donor	Bound volumes	Unbound publications
Nebraska State Engineer's Office, Carson City, Nev.	....	9
Neff, J. B., Anaheim, Calif.	....	134
Nevada State Engineer's Office, Carson City, Nev.	....	9
New Jersey State Board of Health, Trenton, N. J.	....	1
New Mexico State Engineer's Office, Santa Fe, N. M.	....	6
Norcross, Chas. A., Carson City, Nev.	....	5
North Dakota Farmers' Institute, Fargo, N. D.	....	2
North Dakota State Engineer's Office, Bismarck, N. D.	....	7
Ohio State Highway Commission, Columbus, Ohio	3	....
Oregon State Engineer's Office, Portland, Ore.	....	5
Pacific Gas and Electric Co., San Francisco, Calif.	3	10
Pacific Lumber Co., San Francisco, Calif.	2	....
Perkins, George C., Washington, D. C.	12	....
Pennsylvania Dept. of Agr. (Dairy and Food), Pa.	....	129
Pennsylvania Dept. of Agr. (Zoology), Harrisburg, Pa.	....	15
Pennsylvania Free Library, Philadelphia, Pa.	11	....
Philippine Islands, Bureau of Science	....	10
Plymouth Rock Squab Co., Boston, Mass.	1	....
Popenoe, F. W., Altadena, Calif.	1	5
Prange, H. M. G., Jacksonville, Fla.	....	2
Rhode Island Park Museum, Providence, R. I.	....	12
Rixford, E. H., San Francisco, Cal.	1	....
Roeding, Geo. C., Fresno, Calif.	1	2
Robertson, Geo. (State Statistician), Sacramento, Calif.	4	....
Rowell, Chester A., Fresno, Calif.	71	182
Sanford, J. A., Stockton, Calif.	....	8
Saylor, W. H., San Francisco, Calif.	....	1,011
Scotland, Division of Agriculture, Edinburgh	....	13
Sellers, C. H., Sacramento, Calif.	1	....
South Africa, Division of Entomology, Pretoria, S. A.	....	14
South Dakota State Engineer's Office, S. D.	....	2
Sunset Magazine, San Francisco, Calif.	....	140
Teague, R. W., San Dimas, Calif.	....	1
Tennessee State Geological Survey, Nashville, Tenn.	3	12
Utah State Engineer's Office, Salt Lake City, Utah	....	6
U. S. Dept. of Agriculture Library, Washington, D. C.	56	686
U. S. Brewers' Assn., New York	4	....
Volck, W. H., Santa Cruz, Calif.	....	32
Western Pacific Railway Co., San Francisco, Calif.	2	10
Wickson, E. J., University of California	310	8,552
Wight, J. B., Cairo, Ga.	....	6
Woll, F. W., Davis, Calif.	1	....
Woodworth, C. W., University of California	18	....
Wyoming State Engineer's Office	....	11
Total	1,046	16,233

APPENDIX

SMITH-LEVER ACT

[PUBLIC—NO. 95—63RD CONGRESS]

[H. R. 7951]

An Act to provide for co-operative agricultural extension work between the agricultural colleges in the several States receiving the benefits of an Act of Congress approved July second, eighteen hundred and sixty-two, and of Acts supplementary thereto, and the United States Department of Agriculture.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home economics, and to encourage the application of the same, there may be inaugurated in connection with the college or colleges in each State now receiving, or which may hereafter receive, the benefits of the Act of Congress approved July second, eighteen hundred and sixty-two, entitled "An Act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts" (Twelfth Statutes at Large, page five hundred and three), and of the Act of Congress approved August thirtieth, eighteen hundred and ninety (Twenty-sixth Statute at Large, page four hundred and seventeen and chapter eight hundred and forty-one), agricultural extension work which shall be carried on in co-operation with the United States Department of Agriculture: *Provided,* That in any State in which two or more such colleges have been or hereafter may be established the appropriations hereinafter made to such State shall be administered by such college or colleges as the legislature of such State may direct: *Provided further,* That, pending the inauguration and development of the co-operative extension work herein authorized, nothing in this Act shall be construed to discontinue either the farm management work or the farmers' co-operative demonstration work as now conducted by the Bureau of Plant Industry of the Department of Agriculture.

SEC. 2. That co-operative agricultural extension work shall consist of the giving of instruction and practical demonstrations in agriculture and home economics to persons not attending or resident in said colleges in the several communities, and imparting to such persons information on said subjects through field demonstrations, publications, and otherwise; and this work shall be carried on in such manner as may be mutually agreed upon by the Secretary of Agriculture and the State agricultural college or colleges receiving the benefits of this Act.

SEC. 3. That for the purpose of paying the expenses of said co-operative agricultural extension work and the necessary printing and distributing of information in connection with the same, there is permanently appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $480,000 for each year, $10,000 of which shall be paid annually, in the manner hereinafter provided, to each State which shall by action of its legislature assent to the provisions of this Act: *Provided,* That payment of such installments of the appropriation hereinbefore made as shall become due to any State before the adjournment of the regular session of the legislature meeting next after the passage of this Act may, in the absence of prior legislative assent, be made upon the assent of the governor thereof, duly certified to the Secretary of the Treasury: *Provided further,* That there is also appropriated an additional sum of $600,000 for the fiscal year following that in which the foregoing appropriation first becomes available, and for each year thereafter for seven years a sum exceeding by $500,000 the sum appropriated for each preceding year, and for each year thereafter there is permanently appropriated for each year the sum of $4,100,000 in addition to the sum of $480,000 hereinbefore provided: *Provided further,* That before the funds herein appropriated shall become available to any college for any fiscal year plans for the work to be carried on under this Act shall be submitted by the proper officials of each college and approved by the Secretary of Agriculture. Such additional sums shall be used only for the purposes hereinbefore stated, and shall be allotted annually to each State by the Secretary of Agriculture and paid in the manner hereinbefore provided, in the proportion which the rural population of each State bears to the total rural population of all the States as determined by the next preceding Federal census: *Provided further,* That no payment out of the additional appropriations herein provided shall be made in any year to any State until an equal sum has been appropriated for that year by the legislature of such State, or provided by State, county, college, local authority, or individual contributions from within the State, for the maintenance of the co-operative agricultural extension work provided for in this Act.

Sec. 4. That the sums hereby appropriated for extension work shall be paid in equal semi-annual payments on the first day of January and July of each year by the Secretary of the Treasury upon the warrant of the Secretary of Agriculture, out of the Treasury of the United States, to the treasurer or other officer of the State duly authorized by the laws of the State to receive the same; and such officer shall be required to report to the Secretary of Agriculture, on or before the first day of September of each year, a detailed statement of the amount so received during the previous fiscal year, and of its disbursement, on forms prescribed by the Secretary of Agriculture.

Sec. 5. That if any portion of the moneys received by the designated officer of any State for the support and maintenance of co-operative agricultural extension work, as provided in this Act, shall by any action or contingency be diminished or lost, or be misapplied, it shall be replaced by said State to which it belongs, and until so replaced no subsequent appropriation shall be apportioned or paid to said State, and no portion of said moneys shall be applied, directly or indirectly, to the purchase, election, preservation, or repair of any building or buildings, or the purchase or rental of land, or in college-course teaching, lectures in colleges, promoting agricultural trains, or any other purpose not specified in this Act, and not more than five per centum of each annual appropriation shall be applied to the printing and distribution of publications. It shall be the duty of each of said colleges annually, on or before the first day of January, to make to the governor of the State in which it is located a full and detailed report of its operations in the direction of extension work as defined in this Act, including a detailed statement of receipts and expenditures from all sources for this purpose, a copy of which report shall be sent to the Secretary of Agriculture and to the Secretary of the Treasury of the United States.

SEC. 6. That on or before the first day of July in each year after the passage of this Act the Secretary of Agriculture shall ascertain and certify to the Secretary of the Treasury as to each State whether it is entitled to receive its share of the annual appropriation for co-operative agricultural extension work under this Act, and the amount which it is entitled to receive. If the Secretary of Agriculture shall withhold a certificate from any State of its appropriation, the facts and reasons therefor shall be reported to the President, and the amount involved shall be kept separate in the Treasury until the expiration of the Congress next succeeding a session of the legislature of any State from which a certificate has been withheld, in order that the State may, if it should so desire, appeal to Congress from the determination of the Secretary of Agriculture. If the next Congress shall not direct such sum to be paid, it shall be covered into the Treasury.

SEC. 7. That the Secretary of Agriculture shall make an annual report to Congress of the receipts, expenditures, and results of the co-operative agricultural extension work in all of the States receiving the benefits of this Act, and also whether the appropriation of any State has been withheld; and if so, the reasons therefor.

SEC. 8. That Congress may at any time alter, amend, or repeal any or all of the provisions of this Act.

Approved, May 8, 1914.

AGRICULTURE HALL

The headquarters of the College of Agriculture and the Agricultural Experiment Station of the University of California is on the University campus, Berkeley. There are important activities at the University Farm, Davis, the Citrus Experiment Station, Riverside, the Southern Pathological Laboratory, Whittier, the Kearney Park Experiment station, Fresno, and the Imperial Valley Farm, El Centro.

UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE

REPORT

OF THE

COLLEGE OF AGRICULTURE

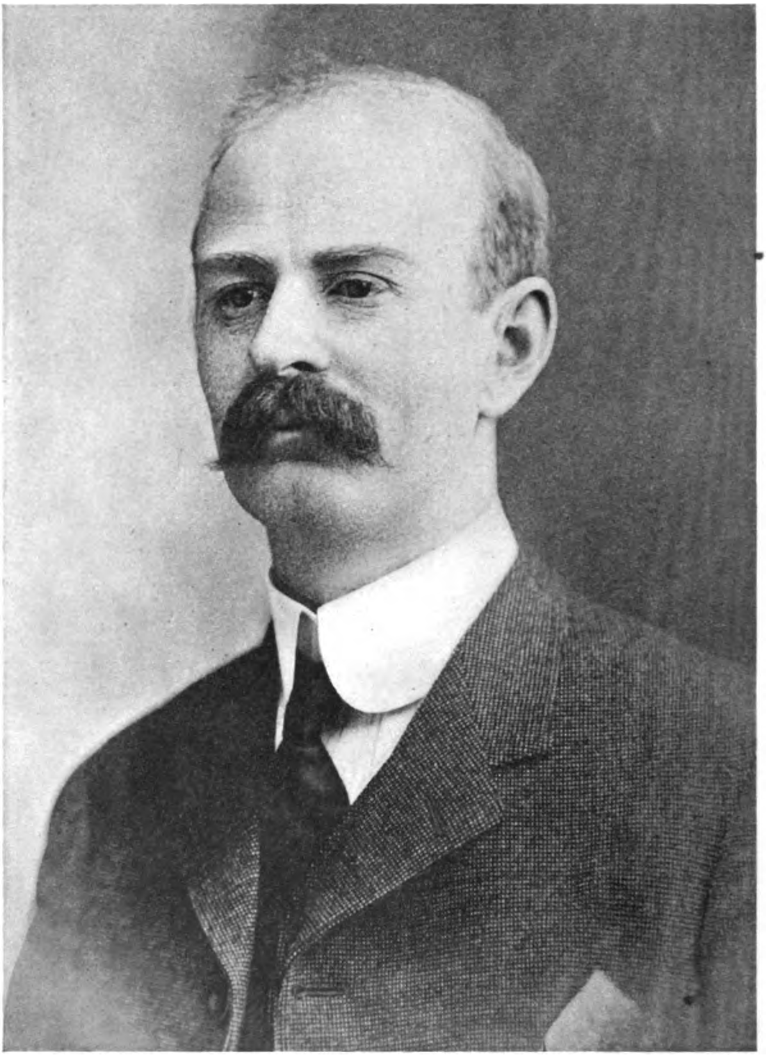
AND THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF CALIFORNIA

FROM JULY 1, 1914, TO JUNE 30, 1915



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REPORT OF THE DIRECTOR

To the President of the University of California:

Sir: The activities and responsibilities of the Department of Agriculture involving research and instruction, both resident and non-resident, are so varied that it is not feasible each year to review all of them in the Annual Report. This year emphasis will be placed on results of investigations, particularly those achievements which have a direct bearing on the agricultural industries of the state.

If the work of the Department of Agriculture be divided into three parts—(1) research, (2) resident instruction, (3) non-resident instruction or so-called agricultural extension—it will be found that about 25 per cent of the time and energy of the staff is devoted to that most important and fundamental part of the work, research, or the creation of new knowledge. Few people realize what a large portion of the time of the members of the staff is devoted to transmitting to the people of the state the result of their inquiries rather than in discovery. Yet the primary purpose of the Agricultural Experiment Station is discovery and not instruction; without it there can be no progress.

SOIL FERTILITY

The deeper this station delves into the subject of soil fertility the more it becomes evident that under arid conditions the widely varied manifestations of decreased yields and abnormal growth are due to one primary cause. Whether it is Mottle Leaf in orange trees, Little Leaf in peach trees or low yields of wheat, the cause appears to be the inability of the plant to secure and assimilate a proper supply of nitrogen.[1] There may be a total lack of nitrogen, but the investigations of Lipman point to the probability that the chief cause of the inability to secure nitrogen is to be found in the factors which surround the processes of nitrification in the soil. As is well known, many factors affect the nitrifying power of the soil and it is becoming more evident that these factors are of greater importance in an arid than in a humid climate. Lipman and Burgess have further shown that the so-called low grade nitrogen fertilizers are, under arid conditions in California, more readily nitrified per unit of nitrogen than those fertilizers containing a higher percentage of nitrogen.

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[1] This statement must not be taken as a finality but as a working hypothesis.

From the results of this station, there is reason to believe that nitrate of soda is a relatively inefficient carrier of nitrogen when applied to citrus orchards. While the evidence upon this point is not complete and will not be probably until our investigations have proceeded for five or ten years longer, yet in the light of present knowledge, the station would advise citrus growers to substitute for nitrate of soda a low-grade nitrogenous fertilizer, such as steamed bone meal, cotton seed meal, dried sludge or garbage tankage and sulphate of ammonia over at least a portion of their orchards in all cases where additional nitrogenous fertilizers are required. Stable manure is always desirable when economically available.

AVAILABILITY OF FERTILIZER NITROGEN IN ARID SOILS

In work with twenty-nine types of soils tested with sulphate of ammonia, dried blood, high-grade tankage, fish guano, steamed bone meal, cotton seed meal, goat manure, and calcium cyanamid, Lipman and Burgess found that as a general rule the nitrogen of low-grade organic fertilizers is much more readily nitrified than that of high-grade materials in humus-poor arid soils. Frequently the nitrogen of the high-grade materials is not nitrified at all in the usual laboratory incubation period. Additions, for example, of 1 per cent of dried blood, tankage or fish guano to soils may in a month's incubation induce losses of the original nitrogen supply in the soil rather than augment it through nitrification. In special investigations along these lines it was found that the nitrogen of dried sewage sludge belongs in the same class with the low-grade organic nitrogenous fertilizers.[2]

Sulphate of ammonia may be used with good results in all arid soils when nitrogen is required, though it is of much greater service in some than in others.

LITTLE LEAF

This disease attacks many different kinds of trees. It occurs to a wide and serious extent in the San Joaquin Valley. Especially on peaches, it is the cause of severe loss. Two very common ideas have been in existence, namely, that the disease is due to gall-forming nematodes upon the roots or that it is the effect of crown gall. Extensive examinations by this station have shown that while both of these conditions are common in trees or orchards affected with Little Leaf, still there are many cases where Little Leaf is not accompanied by either of these troubles and therefore must be due primarily to some other condition. Two facts have been found very pronounced as to the occurrence of this disease, namely, that affected trees are usually located either in streaks of sandy or very light soil running through the orchard or that they are planted in places where corrals or barnyards were formerly located. The latter condition is very common and striking in the San Joaquin Valley. In the investigations thus far conducted, Little Leaf has always been accompanied by a lack of available nitrogen in the soil. This may be due to a lack of total nitrogen, or, as in the case of the corrals, to a lack of the proper nitrifying power in the soil. In view of the lack of specific knowledge of the causes of this destructive disease, the station advises, so far as possible, planting of peaches be avoided on the type and condition of soil above indicated. The station is ready to give planters the benefit of their rather extensive inquiries and investigations.

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[2] The Utilization of the Nitrogen and Organic Matter in Septic and Imhoff Tank Sludges, by C. B. Lipman and P. S. Burgess. California Sta. Bull. No. 251, pp. 285–296.

SOILS ON WHICH PHYSIOLOGICAL DISEASES OCCUR

Abnormal bacteriological conditions have been found in soils on which die-back, mottle leaf, little leaf in trees and little leaf in vines occur. Lipman finds that these abnormal conditions consist in a very weak nitrifying power. Such soils are unable to nitrify at all or only in small degree the nitrogen of high-grade organic nitrogenous fertilizers, like dried blood and high grade tankage. These soils which are usually poor in humus can be made to yield nitrates from sulphate of ammonia, dried sludge, cotton seed meal or steamed bone meal.

Experiments in the greenhouse on citrus seedlings with die-back soil have shown that a proper supply of available nitrates will cause an abnormal growth to change to a wholly normal growth. Experiments on mottle leaf in the field are giving similar indications and experiments on overcoming little leaf in vines are in progress along similar lines.

Should the field experiments yield the results which they now promise, the physiological troubles of the plants named above may be eradicated by the use of plenty of easily nitrifiable organic nitrogen, such as some of the green manure crops, but more quickly by using sulphate of ammonia and the low-grade nitrogenous materials above mentioned.

FERTILIZER EXPERIMENTS UPON ORANGES AND LEMONS

During the past eight years the station has been conducting a fertilizer experiment upon oranges and lemons at Riverside. The trees are not yet in full bearing, but already some indication of the trend is becoming apparent. With these young trees distinct effects have been obtained from the use of stable manure, from a complete fertilizer and from nitrogenous fertilizers. Some apparent effect has been obtained from phosphoric acid, but little if any from potash salts, at least as far as the yield is concerned. In another area of the same type of soil it has been conclusively shown that corn, potatoes and sugar beets were increased by plowing down a leguminous cover crop over that which was obtained by turning under a cover crop of barley. A leguminous cover crop supplied as much nitrogen to the soil apparently as was supplied by one thousand pounds of nitrate of soda. In other words, it is not only desirable to supply organic matter to the soil, but preferably this organic matter should be from a leguminous crop.

These investigations have not continued long enough to justify definite conclusions, but the present indications are that steamed bone meal may be wisely added to a young bearing orange orchard if a leguminous cover crop is plowed under annually, on soils similar to the one on which our investigations have been made. If, however, a leguminous cover crop is not used, a liberal application of nitrogen in some form of low-grade nitrogenous fertilizer and sulphate of ammonia is indicated.[3] While the investigations have not thus far shown it, it may be that when the orchard gets under the strain of heavy bearing potash will also be found useful. This at least has been found to be the case with crops in a humid climate. Extended experiments seem to show, beyond a doubt, that there it is possible by means of leguminous crops to keep up the nitrogen supply of the soil, but that phosphorus and potassium must be added from some other source in order to maintain a maximum production.

THE EFFECT OF FERTILIZERS ON SUGAR AND ACID CONTENT OF CITRUS FRUITS

Young reports that differences in sugar and acid contents of citrus fruits under different fertilizer treatments have been found to be comparatively slight. In general, fruits from plats containing potash alone are slighly sweeter than those from other plats. Phosphoric acid plats range second and nitrogen third in sweetness. Fruits from nitrogen plats have uniformly shown a higher percentage of nitrogen. Navel oranges grown on sweet stock have more sugar and less acid than those grown on sour stock.

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[3] Excellent results have been obtained in the experiments at Riverside with dried blood, and with steamed bone meal which carries a small percentage of nitrogen.

COVER CROPS

The experiments on the comparative value of different winter cover crops at the Riverside Station continue to demonstrate the superior value of certain legumes. The best results have been obtained with the Melilotus clover (*Melilotus indica*). A cover crop of this legume turned under has been demonstrated by the comparative yields of corn and potatoes the following year to be more than equal in manurial value to a cover crop of rye turned under plus a fertilization with 1080 pounds of nitrate of soda per acre. The newly introduced cover crop, purple vetch (*Vicia atropurpurea*), has, so far as tested, proved much superior to the ordinary vetch and gives promise of being a very valuable cover crop for use in groves. Its marked resistance to attacks of the plant louse or aphis is one of its good qualities.

SOME ALKALI RELATIONS

Lipman and Sharp have discovered that in crop cylinders the University Farm clay loam may be puddled so as to be almost impervious to air and water through the leaching of alkali salts. This is due to the action of salt leaching on the soil colloids. They have found it possible to render more or less impervious any type of soil tested, no matter how sandy, by the addition and subsequent leaching of salts. New colloids in large quantities are formed by the absorption of sodium from the leached sodium salts. Calcium and magnesium are displaced and leached out in proportion to the amount of sodium retained by the soil. The injurious effects of sodium may be in part or in whole overcome by additions of precipitants for colloids, like lime, soluble salts, strong acids, and organic matter.

Judged by the growth of barley, oats, wheat, rye, and cow peas in these experiments, the total injurious effects on plant and soil of black alkali (sodium carbonate) is less than that of common salt (sodium chloride), or that of the other white alkali (sodium sulphate). Soils containing as much as .5 per cent and .7 per cent of total water-soluble salts have been made to produce a fair growth of barley and alfalfa through the use of sulphuric acid, ferrous sulphate, gypsum and organic matter. The practical application, of the last mentioned results, has not as yet been fully worked out.

ANTAGONISM BETWEEN SALTS AS AFFECTING PLANTS AND SOIL BACTERIA

Lipman has demonstrated the possibility of making alkali salts innocuous to both the higher plants and the soil bacteria by the addition of other salts, even though the latter be themselves toxic. Plants may thus be produced normally in three or four times the salt concentration that is sufficient to injure them seriously when one salt is present alone. Similar factors hold true for the soil bacteria. Additional experiments, now in progress, show that copper and iron salts, as well as calcium, magnesium and sodium salts, may thus be used successfully for antagonism purposes.

PACIFIC COAST KELPS

Investigations by Burd and his co-workers in the Division of Agricultural Chemistry have shown that *Macrocystis pyrifera* contains material quantities of plant food. In the condition in which the dried material would reach the market, it contains about 30 per cent of soluble salts. This kelp contains in such condition about 11 per cent of potash, 1 per cent of nitrogen, and one-half per cent of phosphoric acid. The remaining salts are not of a character or quantity to interfere with the kelp as a fertilizer. The investigations indicate that the other ingredients, such as iodine, cannot be economically recovered. While the nitrogen content is about twice that of fresh manure, it becomes available rather slowly. The most feasible plan of manufacture is merely to dry and grind. It is preferably used in combination with other ingredients as a basis of a mixed fertilizer. This variety of kelp offers an abundant source of potash, but the profits will depend upon the economy of gathering and manufacture and the condition of the market.[4]

ECONOMICAL USE OF IRRIGATION WATER

It becomes more and more evident that the proper utilization of water for power and irrigation is of most fundamental importance to California. Northern and Central California need to profit by the experience of Southern California. It should be brought home to every one that an excessive use of water may reduce the yield, due, in part at least, to reducing the effective root area, and possibly also in part to the inability of the plant to obtain sufficient water from saturated soil. This fact is borne out by numerous investigations made at the University Farm. Large applications have resulted in a waste of water, preventing the plant from getting its proper supply of food and often permanently injuring the soil.

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[4] Economic Value of Pacific Coast Kelps, by J. S. Burd. California Sta. Bull. No. 248, pp. 181–216.

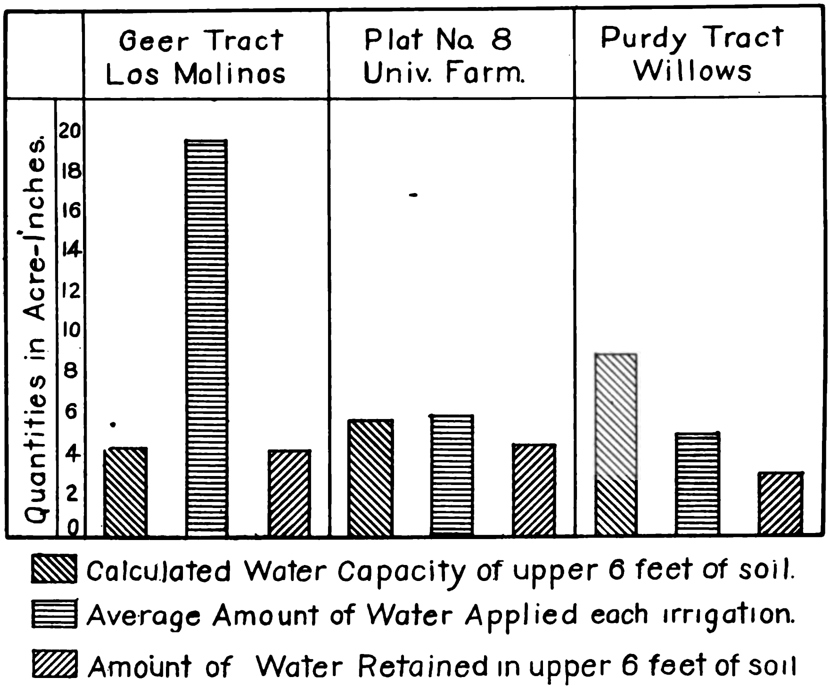
During the past two seasons Adams and Robertson have carried these investigations to about seventy Sacramento Valley farms and find that on the average the same rule of diminishing yield and diminishing profits, where more than thirty acre-inches of irrigation water have been applied to alfalfa, holds equally on those farms, although of course the economical duty of water for alfalfa on very open and very tight clay soils differs considerably. The depth applied annually on the seventy farms has varied from 1.04 to 9.59 feet. On one farm, where the application was 9.59 acre-feet per acre, the yield of alfalfa was only 5.84 tons per acre and on another, where the application was 1.04 acre-feet, the yield was 7.17 tons per acre. In the former case the soil was underlaid with coarse gravel, whereas in the latter case it was a silt loam.

THE DUTY OF WATER

Early studies of the duty of irrigation water in California and other western states were confined to measurements of amounts diverted by canals and amounts applied to farms. During the past year Adams, Beckett, and Israelson have studied the actual requirements of alfalfa, the crop chiefly under observation. More than 18,000 soil moisture determinations were made during the irrigation season of 1914. Certain typical conditions are charted in the accompanying diagrams.

In the case of the Geer Tract, the amount of water applied at each irrigation was nearly five times the calculated water capacity of the first six feet of soil and nearly five times the quantity retained. This illustrates the worst type of practice found. In the case of Plat No. 8 on the University Farm, the calculated water capacity, the quantity applied and the quantity retained were very nearly equal. This illustrates desirable practice. On the Purdy Tract it was impossible to get into the soil more than about one-third of the amount the first six feet could absorb. This is the condition found on almost all the very hard soils studied. It must be remedied through different irrigation practices or soil treatment, or both, before satisfactory yields can be obtained.

It is obvious from these results that it is not economical to apply two acre-feet of water at an irrigation when one-half an acre-foot is all the upper six feet of soil will retain. It is equally obvious that a type of practice that fails to put irrigation water into the soil where the crop can utilize it is faulty.[5]



PENETRATION OF IRRIGATION WATER

The depth to which irrigation water penetrates can be quite easily determined during irrigation by forcing down a sharpened steel rod. Such a rod is usually about one-half inch in diameter and six feet long, with a cross-bar handle similar to the handle of an auger. For tests at other times soil sampling is necessary. For this purpose there can be used an ordinary wood auger with the worm ground off, both sides of the bit slightly rounded and the shank lengthened to about six feet, or a King soil tube, or a two-inch or three-inch soil auger of the posthole type. A short experience in sampling will make it clear whether too little or too much moisture is present. It is obvious that full saturation is never wanted, except with such crops as rice. For most soils, testing a few days after a thorough irrigation, in which, say, a depth of five or six inches has been applied, will indicate about the maximum degree of wetness that is desirable. During the growing season soil in the rooting zone never should be allowed to become so dry that it will not readily pack or "ball" in the hand.

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[5] The irrigation investigations were made in co-operation with the Office of Experiment Stations of the United States Department of Agriculture and with the California State Department of Engineering, under the direction of Mr. Frank Adams, Irrigation Manager in the Office of Experiment Stations.

IRRIGATION AS AFFECTING IMPERIAL VALLEY SOILS

The semi-annual samplings of an Imperial Valley soil, which has been irrigated for two and one-half years, have thus far been six in number. Lipman reports a gradual increase in alkali content, a total transformation of the soil flora, a decrease in the total amounts of plant food ingredients, and marked changes in the physical condition of the soil from the first to the sixth foot in depth due to irrigation. The soil flora has on the whole been changed much for the better, but the physical and the chemical condition appears to have been appreciably injured by irrigation.

TEMPERATURE OF IRRIGATION WATER AS AFFECTING CITRUS SEEDLINGS

Continued experiments by Lipman, which two years ago showed no positive results, are now showing marked effects of retardation of growth of citrus seedlings which received water at temperatures of 39° F., 44° F., 50° F., and even 55° F. The seedlings are stunted in growth and look sickly when they receive water at the first two temperatures. At higher temperatures growth is much better. The maximum growth is obtained with water at about 72° F. Water of higher temperature shows a slight stunting effect on the orange seedlings, which becomes very noticeable at 86° F., the maximum temperature employed in this investigation.

IRRIGATION DEVICES

Examples of the principal irrigation measuring devices have been assembled at the University Farm, where tests are made to determine their accuracy under ordinary field conditions, and incidently to furnish students an opportunity to make practical tests in agricultural hydraulics. These devices have been described by Adams through text, photographs and drawings, and their relative accuracy discussed. Their importance in bringing about an efficient use of water and a just method of payment is emphasized.[6]

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[6] Some Measuring Devices Used in the Delivery of Irrigation Water, by California Agents of Irrigation Investigations, Office of Experiment Stations, U. S. Department of Agriculture. California Sta. Bull. No. 247, pp. 107–182.

DRAINAGE AND RECLAMATION

At the Kearney Ranch, in Fresno County, there is a quarter section of land which a dozen years ago was a flourishing vineyard. It had become so badly alkaline that during the four years previous to the investigations here reported no satisfactory crop was grown, although sown to barley every year.

In October, 1913, four miles of tile drain were laid at the depth of a little less than six feet. The main tile are ten and twelve inches and the laterals are six inches in diameter. Approximately 97,580,000 gallons of drainage water, containing 151.5 tons of alkali, mostly common salt, or 1900 pounds per acre, were pumped from the tract during the season. Extensive tests of the soil show a very decided decrease in common salt but no material change in the black alkali. A rather unsatisfactory crop of Egyptian corn was grown on the east half of the area. After one season's flooding the alkali weed, which was so abundant, has almost wholly disappeared and Bermuda grass is so rapidly taking its place as to become an important factor in the cost of reclamation.

The cost of the drainage system, including pump and motor, was somewhat less than $70 per acre, while leveling the land and operating expenses, including pumping, has cost during the year $15 per acre additional.[7]

SOIL SURVEYS

During the past two years the Division of Soil Technology in co-operation with the United States Bureau of Soils has surveyed nine areas in California and has a tenth area partially completed. These soil surveys with their maps and reports are in effect a graphic inventory of the soils of the state.

The Sacramento Valley Soil Survey covers 6274 square miles. The survey of the San Francisco Bay region, extending from Santa Rosa to Santa Cruz and eastward to the San Joaquin and Sacramento valleys, covers about 4000 square miles, while the San Diego Area covers about 3000 square miles. The seven detailed surveys are the Merced Area, covering the valley portion of Merced County; the Ukiah Area, covering the valley land along the Russian River and its tributaries in Mendocino County; the San Fernando Area, covering the valley of that name; the Honey Lake Area, covering Honey Lake and

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[7] This experiment is being conducted in co-operation with the Division of Drainage Investigations of the U. S. Department of Agriculture, with Mr. W. W. Weir in immediate charge.

Long valleys; and the Pasadena and San Bernardino areas, which together cover the valley lands east of Los Angeles.

In each survey the land is carefully examined and a map prepared showing by colors the area and location of each kind of soil. These maps are printed on suitable base maps showing roads, streams, railroads and section lines. From them it is possible to locate a ranch or piece of property and to determine the character of the soil.

THE SOIL SURVEY OF THE SACRAMENTO VALLEY

The Report on the Soil Survey of the Sacramento Valley Area, which was started in July, 1913, and completed in February, 1914, has been issued from the press and is now available for distribution.

The survey is the first to be issued since the co-operative soil survey work with the United States Department of Agriculture was started. The area was surveyed by a field force composed of two men from the Bureau of Soils and three men from the University, besides two additional men, one from each institution, who spent the larger part of the season in the field in inspection and correlation work.

The area surveyed covers an area of 6274 square miles. This includes the Sacramento Valley from Red Bluff south nearly to Stockton (to 38° N latitude) and from the foothills of the Sierras west to the Coast ranges. It covers the valley floor, the valley slopes, and portions of the lower foothill areas.

Thirty-nine series or groups of soils were recognized in this area. These groups include about one hundred distinct types, but many of the latter occur in such small areas that they could not be shown separately on the map. Of these thirty-nine series, seven are residual soils from consolidated rocks. These occur along the valley margins and on Marysville Buttes and generally occupy a rough topography. They are mainly used for pasture, although some of the residual soils on the east side of the valley are being used very successfully for orchards.

Ten series are classed as being derived from old valley filling material. These soils occupy the valley slopes, mesas, and rolling valley margins and are formed by the erosion and weathering of old sedimentary deposits. These soils generally have a heavy subsoil and, in the case of the Redding and the San Joaquin, the two most extensive series, have red cemented hardpan at from two to three feet below the surface. Where not too shallow the soils are quite productive.

Sixteen soil series were recognized as being derived from alluvial fan or recent valley filling material. These soils represent the most recent alluvial deposits and occupy the lower slopes, alluvial plains and the basin-like floor of the valley. The soils are quite productive and are generally free from hardpan. Where drainage is restricted or poor they are liable to be alkaline.

The major part of these soils is being dry-farmed to grain, but with irrigation the soils will be found well adapted to fruit and truck crops.

One series was classed as Aeolian or wind-laid, while five groups of soils were included under the head of miscellaneous. Most important of these latter is the Muck and Peat group, comprising a large area near the junction of the Sacramento and San Joaquin rivers. These soils occur as a large number of islands, low and flat, lying about at sea level. When diked and drained the soils are very productive, and are being cropped extensively to potatoes, asparagus, beans, onions and other truck crops.

At the present time the larger part of the area is in rather large ranches, the land being used for the production of grain, grain hay and for pasture. Wherever water has been developed for irrigation more intensive types of farming are found. Alfalfa and fruit are generally grown under irrigation, the latter including peaches, almonds, apricots, prunes, cherries, olives, citrus fruits and grapes. These fruit crops are grown, to a greater or less extent, in different parts of the area, and with the extension of irrigation a greater development of intensive farming will take place.

In the report of the survey, the suitability of the soils to any of these crops is pointed out wherever it could be determined.

The report has separate chapters dealing with the alkali problem, with flood control, with drainage, and with general agricultural conditions.[8]

AVOCADO

On account of the demand for information and the possibility of over-exploitation, Condit has prepared a statement concerning the culture, production and marketing of the avocado in Califorina.

Jaffa analyzed twenty-eight samples of native-grown avocados. He found the total solids in the edible portion to be greater than that of any other fruit, the nearest approach to it being the banana, which is 5 per cent lower. The avocado is high in protein and mineral matters, but its chief value as a food is due to the high fat content, which averages 20 per cent.[9]

LOQUAT

During the past two years material concerning the culture and marketing of the loquat has been gathered by Condit through visits to nurseries, orchards and markets, by the study of the trees and fruit collected from different sources and by extensive research into the literature. The botanical characters, climatic requirements, methods of propagation, soils, culture and methods of harvesting, packing and marketing are discussed in a recent bulletin.[10]

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[8] Reconnaissance Soil Survey of the Sacramento Valley, California, by L. C. Holmes, J. W. Nelson and party, U. S. Department of Agriculture, Advance Sheets. Field Operations of the Bureau of Soils, 1913, pp. 1–148.

[9] The Avocado in California, Part I, Culture, Production and Marketing, by I. J. Condit; Part II, Composition and Food Value, by M. E. Jaffa. California Sta. Bull. No. 254, pp. 381–402.

DATES

Approximately 3500 date seedlings have been grown on the Imperial Valley Experiment Farm. Over 1000 of these have been distributed in Imperial Valley. The seedlings represent ten different varieties. Some of the seed was from stock of known parentage. The Deglet Noor-Purdy cross is perhaps the most promising of the seedlings. One palm of this cross produced ripe dates in August. Some of the palms bore fruit in the fall of 1914, when four years old. Although the fruit was uneven, much of it was good. In addition to the seedlings, offshoots of fifteen varieties have been planted. The date palm promises to be one of the main fruit crops of the valley. As the palms are very resistant to alkali, the date will probably be used to make the otherwise waste places bear profitable crops.

MATURITY IN ORANGES

Since the publication a little less than a year ago of Alsberg's statement as to the maturity standard of eight parts of total solid to one part of acid in oranges Coit has made serial tests from different parts of Northern California. He found that some districts which were supposed to produce early oranges do not bring them so early to maturity.

Navel oranges from Kern County reached the standard of maturity the latter part of October. Tulare district came in during early November. Butte County districts had mature oranges by the middle of November, while the oranges at Fair Oaks, Sacramento County, and at Orland, Glenn County, reached maturity about the first of January. A variation was found in the total solids to acid ratio of more than 100 per cent between individual oranges in a commercial pack. Oranges on the outside of the tree matured earlier than those on the inside. The juice from different parts of the same orange often varied as much as 15 per cent, there being considerably more sugar obtained from the juice near the navel than near the stem.

In testing oranges, therefore, it is important to use a large number in each sample and to include both halves of each orange.

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[10] The Loquat, by I. J. Condit. California Sta. Bull. No. 250, pp. 249–284

BENCH ROOTS

The cause of bench root in citrus nursery stock has been discovered and a remedy suggested by Ralston, a student in the College of Agriculture, who undertook the investigation as a thesis. The amount of bench root in sour stock seedlings was found to be 24 per cent. The cause was not due to a condition of the soil or the position of the seed in the soil, as had previously been supposed, but to the inability of the root to penetrate the tough and fibrous seed coat before encircling the cotyledons in an effort to get out. Seeds having had the seed coats removed before planting showed no bench root whatever. Soaking the seed before planting was found to reduce the bench root to 10 per cent.

SOUR SAP IN NURSERY STOCK

Recent investigations by E. H. Smith of the Division of Plant Pathology have shown that the fungus discovered by R. E. Smith to be the cause of brown rot of lemons, and by Fawcett, the most common form of Gummosis in citrus trees, is the cause of so-called Sour Sap, which has resulted in extensive losses in nursery stock. The importance of this soil fungus as a cause of fruit tree disease is becoming more and more apparent, although its existence was never suspected until it was discovered by Smith to be the cause of brown rot on lemons.[11]

GUM DISEASES OF CITRUS TREES

Fawcett has demonstrated the existence of at least two types of the so-called gum diseases (or gummosis) on the lemon caused by different fungi. The results of former experiments continue to demonstrate the superiority of Bordeaux paste as a curative treatment for the different forms of the disease. Another gum disease known as psorosis (or scaly bark), affecting the orange, has also been investigated. The disease appears to be of fungus origin, although this has not been definitely proved. Treatments with Bordeaux paste give evidence of being very satisfactory.

SHORT LIFE IN DECIDUOUS FRUIT TREES

Investigations by the Division of Plant Pathology have shown that the age and productive capacity of many of the deciduous orchards are being reduced fully one-half by wood decay fungi. This loss is largely avoidable by proper pruning, disinfecting large cuts with corrosive sublimate, and afterwards keeping the cuts covered with asphaltum. Perhaps there is nothing which would add so much to the permanency and productivity of deciduous fruit trees in California as attention to this one simple detail.

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[11] The Brown Rot of the Lemon, by Ralph E. Smith. California Sta. Bull. No. 190, pp. 1–72.

Two Fungi as Causal Agents in Gummosis of Lemon Trees in California, by H. S. Fawcett. California State Com. of Hort., Vol. II, No. 8, pp. 601–617.

OLIVE KNOT

This bacterial disease causes large swellings, knots or tubercles, on the branches and trunk and interferes seriously with the growth and production of the tree. The investigations by Horne have shown that there is much difference in the susceptibility of different varieties of the olive to this disease. The universally popular Mission variety is comparatively free and resistant to it. The Ascolano and the Sevillano, two popular large-fruited varieties, are also comparatively free from the disease. The Manzanillo, a variety which is considerably planted, is very susceptible to the knot disease. The nature of the disease has been very thoroughly worked out by the station, and it has been found that by far the best method of prevention and control is by cutting out the knot at the very first appearance, so that it may never get a start in the orchard.

OAK FUNGUS

(Armillaria Root Rot)

Horne has found that this most insidious and destructive plant disease, due to a toadstool fungus, may under some conditions be controlled by trenching. Further, it has been discovered that the parasite may be actually killed by means of bisulphide of carbon. It is known that citrus trees, prunes, peaches, apricots, and almonds are attacked, while pears, black walnuts, and figs are immune. The latter may therefore be used for planting where conditions otherwise favor.

CURLY TOP OF THE SUGAR BEET

The future of the sugar beet industry west of the Rocky Mountains appears to be dependent upon the control of the leaf-hopper, a minute insect no larger than a pinhead. That the very destructive disease known as Curly Top resulted from the sting of this minute insect was first pointed out by Ball of Utah. It remained, however, for Smith of this station to isolate an organism in the beet and connect the organism with the leaf-hopper. In other words, the transmission of an organism from an insect to a plant and the necessity of such insect transmission as a causal agency has been pointed out for the first time.

The condition is analogous to the transmission of the malarial organism through the mosquito. It has been further shown by the investigations of this station that not only must the organism pass from insect to plant but the sugar beet must be grown in a sufficiently high temperature or the organism will not develop and become destructive. Hence it appears that the sugar beet can be grown successfully in California when the leaf-hopper can be controlled or by planting at a time or place where temperature, during the growing season, remains comparatively low.

WALNUT SPRAYING

The control of diseases and insects which attack the walnut trees has been thoroughly effected by the Division of Plant Pathology by the use of the M. A. C. spray nozzle and power spraying outfit of greater force than usually employed. By spraying walnut trees with lime-sulphur just before growth starts in the spring material increase of the crop has been produced in almost every instance. For the best results the station recommends the spraying with lime-sulphur just before the growth starts and another spraying with Bordeaux mixture about the time that the young nuts are as large as peas. Through the methods which the station has developed, large walnut trees can be sprayed twice at a total expense of not over 75 cents per tree. To offset this outlay, an increase of about six pounds of walnuts per tree would be necessary. In some of the experiments an average increase of more than fifteen pounds has been obtained even on medium sized trees.[12]

VARIATION IN BLACK WALNUT TREES

In 1901 a walnut tree was discovered which in appearance superficially resembled a live oak tree. Two questions arose: (1) was it a hybrid, (2) was this variation a fixed characteristic which would be reproduced in succeeding generations? Babcock has found that this new walnut originated from the seed of the California black walnut, and he has shown that it was not caused by cross pollination with any other walnut or with live oak, as had been supposed. In 1908 crosses were made with pollen from this oak-like walnut tree on black walnut and eleven trees were secured. Thus far only one individual among the progeny of this hybrid has shown any of the oak-like characters.

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[12] Spraying Walnut Trees for Blight and Aphis Control, by Ralph E. Smith, assisted by T. Francis Hunt and W. H. Nixon. California Sta. Circ. No. 107, pp. 1–8.

A year ago Babcock discovered a black walnut tree which produces a small percentage of this type each year, while more recently he reports one tree of a Northern California black walnut producing the same form. It is thus shown that these same characters may occur in two species or in two rather distinct varieties of the black walnut tree.[13]

MELAXUMA OF ENGLISH WALNUT

Fawcett has discovered cankers similar to those occurring upon the walnut and produced by the same organism on the native willow growing in cañons in the vicinity of badly infected walnut groves. Observations lead to the conclusion that the disease has spread from the willow to the walnut. Treatments and preventive experiments, comprising both spraying and tree surgery methods, are now under way.

VINE PRUNING

As the result of many years of investigation and study, Bioletti has prepared a complete compendium on the pruning of grapes in California. This exhaustive and discriminating study will doubtless be the standard source of information for many years.[14]

FRUIT STAINS, SPOTS AND ROTS

In connection with further studies on fruit stains, spots, and rots, the wither-tip fungus (*Colletotrichum gloesoporiodes*) has been proven by Barrett to be the cause of the dull reddish green stain so common on oranges and lemons during the spring of 1914. The trouble has been of less importance this year.

An interesting observation has been made that the oil from lemons and oranges is toxic to the fruit rind, and very small amounts when the surrounding atmosphere is moist produce injury. At times this injury is identical in appearance to the so-called green spot. It seems that this fact offers an explanation of at least one possible cause of this peculiar and frequently destructive spot.

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[13] Rept. Col. of Agr. and Exp. Sta. Univ. of Cal., 1912–13, p. 50; 1913–14, pp. 120–122.

Babcock, E. B. Studies in Juglans, I. Study of a New Form of *Juglans californica* Wats. Univ. Cal. Pub. Agr. Sci., Vol. 2, No. 1 (1913). II. Further Notes and Observations on a New Form of *Juglans californica* Wats. *Ibid.*, Vol. 2, No. 2.

A New Walnut. Jour. Heredity, Vol. VI, No. 1 (1915).

[14] Vine Pruning in California, Part I. California Sta. Bull. No. 241, pp. 1–48. Vine Pruning in California, Part II. California Sta. Bull. No. 245, pp. 53–108.

CROWN GALL

The study of the resistance of various sorts of Prunus to artificial inoculation with the crown gall organism (*Bacterium tumefaciens*) has been continued by C. O. Smith. The conclusions suggested by the previous experiments have been confirmed and resistance in other Prunus stocks discovered. The stocks showing marked resistance are to be further tested: (1) by artificial inoculation with various strains of *Bacterium tumefaciens,* (2) by growing seedlings in infected soil. The results of experiments in dipping the roots of peach in disinfecting solutions, such as Bordeaux mixture, Bordeaux paste, and lime-sulphur, show that these cannot be used without seriously affecting the vitality of the trees.

PEACH BREEDING

In 1909 C. O. Smith and Babcock made crosses between the Peento or Chinese saucer peach, *Prunus platycarpa,* and several commercial varieties and seedlings of common peach, *Prunus persica.* From the original seedlings growing at Whittier some five hundred self-fertilized fruits are being obtained. Budded trees of most of the Whittier hybrids and a considerable collection of other types of peaches are now growing at Berkeley.

STOCK-POISONING PLANTS

The causes of poisoning of stock by plants are not fully understood. The plants which commonly cause death, however, are now generally known to investigators. Hall and Yates of the Department of Botany have named and described six plants as the most important stock-poisoning plants in California, as follows: Water Hemlock, Death Camas, Larkspur, Milkweed, Lupines, and Loco weeds. The habitat and poisonous characters of each are given, together with symptoms produced, the remedies and, what is most important, the preventive measures to be adopted.[15]

DEPRECIATION OF LUMBER DURING SEASONING

Pratt of the Division of Forestry has shown that the amount of depreciation in the value of lumber during seasoning in the Northern Sierras may cause a money loss of $2.50 to $12 per thousand feet in the upper grades of sugar pine, while the loss in western yellow pine

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[15] Stock Poisoning Plants of California, by H. M. Hall and H. S. Yates. California Sta. Bull. No. 249, pp. 217–248.

(California white pine), the upper grades of which are kiln-dried, average about $1.55 per thousand board feet. The losses in the sugar pine may be reduced by the better methods of kiln-drying.[16]

YIELD OF CEREALS

During the season of 1914 the Division of Agronomy reports that at the University Farm, Davis, with a system of biennial cropping and without irrigation, Cumberland wheat (51.6 bushels), red Algeria oats (100.6 bushels), and improved common barley (76.8 bushels) gave the highest yields. There were 63 varieties of wheat, averaging 28.8 bushels; 18 varieties of oats, with an average yield of 61.4 bushels; and 36 varieties of barley, which averaged 52 bushels per acre. The rainfall for the year ending June 30 was 28.70 inches; for the previous year 8.84 inches.

INDIAN CORN

Gilmore reports trials with 36 varieties of Indian corn at the University Farm. Thus far U. S. 160, Minnesota 113, Reed's Yellow Dent and Leaming have given the most promising results. It has been especially noted that some of these varieties gradually improve as they become acclimated to local conditions.

SORGHUM CULTURE

Gilmore reports trials with 19 varieties of grain sorghums at the University Farm. The best yields were obtained with Dwarf Milo, Feterita and Brown Durra, in the order mentioned. Six varieties of sweet sorghum were tested for forage. Honey sorghum gave the best results, yielding 26 tons of green forage per acre.

GRAIN FOR IMPERIAL VALLEY

Packard has grown 17 varieties of wheat and 12 varieties of barley at the Imperial Valley Experiment Farm during the past three years. The varieties of wheat have given better results than the varieties of barley, although barley is grown almost exclusively in Imperial Valley. No rust was noted on the wheat. The common California and the Beldi barley proved to be so much superior to other varieties tried that the tests of the majority of the barley varieties have been discontinued.

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[16] The Deterioration of Lumber, by Merritt B. Pratt. California Sta. Bull. No. 252, pp. 301–320.

Of 18 varieties of sorghum which have been grown, three stand out superior to all others. Shallu or Egyptian wheat has given the best yield of sorghum grain and grows very well under adverse conditions. Milo, which is most commonly grown in this section, compared favorably with other varieties, although Feterita seemed to have some advantages. The Feterita was the earliest, giving it a special value in a section where two or three crops are grown on the same land in a single season. Although Egyptian corn yielded well, the habit of shattering badly prevents its being grown extensively.

SUDAN GRASS

The Sudan grass experiment, started at the University Farm, Davis, in April, 1913, through co-operation with the Bureau of Plant Industry, has shown this plant to be a valuable annual forage crop in subhumid sections where irrigation is not practiced. In 1914 the average yield of cured hay under irrigation was 7.61 tons per acre, while the average yield under dry-farming methods was 6.61 tons per acre. As a seed crop the average yield with irrigation was 1643 pounds, and without irrigation 1771 pounds per acre. Additional trials are being made to determine the best methods of seeding and handling this crop. Care must be taken in the purchase of seed, owing to the fact that there is no known method of distinguishing between the seed of Sudan grass and that of Johnson grass.

INFLUENCE OF CLIMATE AND SOIL ON COMPOSITION OF WHEAT

Madson reports that experiments in co-operation with the United States Department of Agriculture at the Kansas, Maryland, South Dakota, and Texas experiment stations and including some trials at the University Farm, Davis, indicate climate, together with available moisture supply, to have the greatest influence on the composition and milling quality of wheat. The soil, on the other hand, especially with regard to the physical conditions and moisture-holding capacity, exerts the greatest influence on yields. The physical and moisture conditions naturally affect nitrifying organisms and therefore the supply of available nitrogen. The Crimean winter wheat which has been grown continuously at this station for a number of years has almost entirely lost its spreading habit of growth, while the seed of this variety introduced either from Texas or Kansas always presents the spreading character.

CLOSE PLANTING OF EGYPTIAN COTTON

Egyptian cotton when allowed to grow under ordinary conditions at the Imperial Valley Experiment Farm reaches a height of six or seven feet, with large vegetative branches, which makes picking difficult. Different distances of planting were tried and resulted in very striking advantages in favor of close planting. The cotton plants were smaller, with fewer vegetative branches, than when planted far apart and the yield per acre was greater, although the yield per plant was reduced. Most of the cotton was produced on the fruiting branches of the main stock and very little on the vegetative branches. The same general results were obtained with Durango cotton, although the differences were not so marked. The quality of the fiber seems to be maintained by this method of planting.

ALFALFA FOR IMPERIAL VALLEY

Packard reports that common alfalfa, although not so rapid a winter grower as the Arabian or Peruvian, is perhaps the best all-around alfalfa for Imperial Valley. Peruvian alfalfa, which is a rapid winter grower, promises to meet the general requirements of the valley. The Arabian alfalfa grows rapidly during the winter months and produces a good quality of hay, but will not stand pasturing. Turkestan alfalfa proved to be poorly adapted to conditions in the Imperial Valley. The growth was very slow in winter and the quality of hay was not good.

JOHNSON GRASS ERADICATION

Johnson grass was eradicated on a tract of about three acres of the Experiment Station at Fresno. After the plot had been plowed and worked down to a good mulch in the spring it was gone over with a knife weed cutter at intervals of about ten days from the first of May to the 20th of August. By that time the Johnson grass was entirely killed. The knives on the weed cutter were regulated to cut about three inches beneath the surface of the ground. The plants never reached a height of over three or four inches before being cut and were never cut until they were high enough to show plainly. The work was not done on a large enough scale to give accurate cost data. It is probable, however, that the cost of eradication will run from six to as high as fifteen dollars an acre, according to the character and condition of the field to be worked. The extent of infestation is not such a serious factor as the length of time it has been established; the longer it is established the more difficult it is to eradicate.

FUMIGATION METHODS

Woodworth has shown that while fumigation with cyanide is the most practical method of control of scale insects on citrus trees, absolute eradication is impossible because of the physiological variation in susceptibility to the action of the poison. Normally there will be many survivals on each tree in an orchard under any dose which it is safe to apply. This investigation has covered a period of five years and has involved 50,000 separate tests. Mass variation was found to be quite as much in evidence as individual variation. There was no consistent variation that could be associated with the kind of food or climatic differences. No part of the state showed a greater or less susceptibility than another, but within each district very restricted localities exhibited much higher or lower resistance. Woodworth has further shown that the atmospheric condition as regards dryness is important in its effect upon tent leakage, rather than because of its effect on the susceptibility of the insects. Proof of cyanide stimulation has for the first time been secured both as regards plants and animals. Long continued treatment just below toxic strength accelerates the germination of seeds and growth of seedlings and increases the percentage of germination. Likewise the percentage of hatch of scale insect eggs is positively increased by under-fumigation.

THE CITRICOLA SCALE

The citricola scale has come to be among the most injurious citrus pests. It is most injurious in the citrus sections of the San Joaquin Valley, where general spraying and fumigation was inaugurated for the first time last year. The distribution, life history and control measures affecting California have been determined by H. J. Quayle.[17]

MEALY BUGS

Four species of mealy bugs generally attack citrus trees, one of which has been determined by Quayle to be a new species. The biology of the four citrus species, including that of their predaceous enemies and parasites, has been largely worked out and a considerable advance has been made in control.[18]

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[17] The Citricola Scale, by H. J. Quayle. California Sta. Bull. No. 255, pp. 403–422.

[18] The Mealy Bugs of Citrus Trees, by C. P. Clausen. California Sta. Bull. No. 258, pp. 17–48.

IMPROVED METHODS IN WINERIES AND VINEGAR FACTORIES

Analyses by Cruess of the wines made in 1914 by twenty-three wineries demonstrated the value of the proper use of sulfurous acid and pure yeast. These same methods, introduced into cider vinegar factories, resulted in a notable increase in the quality and strength of the vinegar. Contrary to the usual supposition, small quantities of sulfurous acid used before the alcoholic fermentation were found to favor the completion of the subsequent acetic fermentation.

COATINGS FOR CEMENT VATS

Laboratory tests by the Division of Viticulture and Enology indicate that coating of mixed paraffin and beeswax, paraffin, rosin and beeswax, tasteless fossil asphalt, such as Gilsonite, applied in solution or melted with paraffin or Saracen wax, are more satisfactory than any of the commercial paints tried.

OLIVE BY-PRODUCTS

The possibility of making a nutritious and palatable food product in the form of a paste from olives too small for pickling or otherwise unsuitable has been shown by the Division of Viticulture and Enology. Several hundred pounds were treated in an olive pickling factory.

It was found that a paste or mince could be made from the olives either before or after pickling. The yield was 161 pounds from 200 pounds of fresh olives and 130 pounds from 200 pounds of pickled olives. The color of the former was a little lighter, but any depth of color can be obtained by modifications in the methods of preparation. An excellent paste was made also from green olives fermented and pickled by the Spanish process.

FRUIT BY-PRODUCTS

Methods of producing clear, palatable jellies from oranges and from lemons have been devised by Cruess. One ton will yield approximately 300 gallons, or 6000 six-ounce glasses. Methods of clearing orange and lemon juice were tested. Fining with 8 to 12 pounds of Spanish clay, settling and filtration were found satisfactory. Small amounts of sulfurous acid prevent darkening and the development of a "musty" taste.

RAISIN MAKING

Bioletti has shown the advisability of harvesting raisin grapes at a more advanced stage of ripeness than is usually done.

The crop of Muscat raisins at Kearney increased 48.3 per cent between August 12 and September 23, and the estimated net profits, based on a selling price of 5 cents a pound, from $87 per acre to $155, or 75.9 per cent. The increase at Davis from August 26 to September 23 was 12 per cent in crop and 18 per cent in net profit. The increase in Sultaninas from August 5 to October 1 at Kearney was 34.1 per cent in crop and 47.9 per cent in net profit.

Much of this increase is often lost by harvesting the grapes too early. It could not all be saved for two reasons: (1) It is practically impossible to gather all the crop at the advanced stage of ripeness corresponding to the maximum crop, and (2) raisins made from the ripest grapes, while of the best quality for eating, are too "sticky" for the usual methods of handling in California. If the start of harvesting were deferred until the Muscat showed 25° Bal.—the average would be about 26° Bal. for the whole crop—the crop would be of excellent quality and much larger than is usual now. Observations in six Muscat vineyards near Fresno indicated a loss from too early picking of from $12 to $22 per acre, or $16 as an average for all.

The time required for drying increased in one experiment from 13 days for Muscats gathered August 17 to 34 days for those gathered September 16.

The number of pounds of grapes required to make a pound of raisins decreases with advancing ripeness. Our tests indicate that 3.4 should be a minimum for Muscat and 3.8 for Sultanina, and a favorable average 3.2 for the former and 3.6 for the latter. Higher ratios indicate insufficient ripeness or losses in handling.

MISTLETOE

Inquiry was made of the Division of Nutrition concerning the composition of mistletoe, since cattle and sheep readily eat the green mistletoe. The analyses tabulated below are made from samples submitted by Mr. Frank C. Clarke, Laytonville, California, in connection with feeding experiments.

	Condition	Water	Protein	Ether extract	Starch, sugar, etc.	Crude fiber	Ash
Whole plant	Air dried	12.00	9.94	7.13	51.57	15.14	4.22
	Fresh	56.88	4.77	3.49	25.37	7.42	2.07
Leaves	Air dried	11.00	9.79	6.84	59.79	9.91	2.67
	Fresh	56.39	4.79	3.55	29.11	4.85	1.31
Stems and branches	Air dried	13.50	7.95	7.61	48.29	16.43	6.22
	Fresh	57.61	3.89	3.73	23.68	8.05	3.04

The figures here reported indicate a comparatively high nutritive value. The protein content of the mistletoe in the fresh condition is fully equal to that of alfalfa. On a water-free basis, however, the comparison is decidedly in favor of the alfalfa. The ether extract is also high. Nevertheless this is an untried material with unknown availability and should be fed with caution.

THE LOSS IN OIL IN PROCESSING RIPE OLIVES

Jaffa analyzed untreated ripe Mission olives and also similar olives which had been treated for eight hours in a 1½ per cent solution of potash and afterwards thoroughly washed free from the lye. The lye treatment took out only an insignificant amount of the oil and did not therefore appreciably lower the food value of the ripe fruit.

BARLEY FOR DAIRY COWS

There appears to be no foundation for the statement often made that barley has an unfavorable influence on the milk secretion and tends to dry up the cows.

Barley as the sole concentrate has been fed to four cows for a number of months past by the Division of Animal Husbandry. One cow, a grade Holstein, which was placed on a ration of alfalfa and rolled barley May 28, 1914, shortly after she freshened, has produced during the last ten months 12,581.4 pounds of milk and 422.84 pounds of butter fat. Last year on a mixed grain ration she gave 8320 pounds of milk and 272 pounds of butter fat during the entire lactation period. The three other cows were placed on the experiment either when dry or during the latter part of their lactation periods and the feeding of barley will be continued throughout subsequent lactation periods.

THE VALUE OF BARLEY FOR COWS FED ALFALFA

The Division of Animal Husbandry has conducted two experiments with feeding barley to cows on alfalfa. An immediate increase in production was secured as a result of the grain feeding, but this increase did not, as a rule, pay for the extra cost of the ration. In addition to the increased production obtained, there was, however, a residual effect of the grain feeding as well as a favorable influence on the condition of the cows and their offspring. The practice of feeding grain to cows on alfalfa was therefore shown to be economically sound. This is especially true for heifers and young cows, as well as heavy-producing animals which cannot be brought to a maximum production on alfalfa.[19]

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[19] The Value of Barley for Cows Fed Alfalfa, by Gordon H. True, F. W. Woll, and E. C. Voorhies. California Sta. Bull. No. 256, pp. 423–445.

ALFALFA AS A CAUSE OF STERILITY IN COWS

It appears to be popular opinion that the exclusive feeding of alfalfa to milch cows has a tendency to sterility. Haring has investigated this subject and finds no evidence to suspect alfalfa of being the cause of sterility. The data already on hand show proportionately less sterility in dairy cattle fed exclusively on alfalfa than in those fed partly on alfalfa or in those receiving no alfalfa at all.

THE SILO IN CALIFORNIA AGRICULTURE

The silo has recently become a common feature of the equipment of dairy and stock farms in the eastern and central states. Also in this state silos are now frequently met with. Special problems relating to the place of the silo in California agriculture have been taken up for study by the Division of Animal Industry along three different lines—the value of different methods of silo construction; the adaptability of different crops for the silo; and the value of the different kinds of silage for the feeding of farm animals, especially dairy cattle, fattening steers and sheep.

Three wooden silos were built at the University Farm during the past year, viz., two stave silos and one resaw silo, each of about ninety tons capacity. With the concrete silo previously erected in connection with the dairy barn, these render it possible to make over 400 tons of silage during the season, or more if desired, by filling the silos both in the spring and the fall. During the past year the following kinds of silage were made and fed out for experimental purposes: alfalfa, Indian corn, sweet sorghum, feterita, Milo maize, and oats. The experiments with these crops that have been completed have been referred to elsewhere in this report.

ALFALFA SILAGE

Silage made from the first cutting of a very weedy alfalfa field in April, 1914, was fed to 107 range steers during July and August, 1914. It was fed with a good second cutting of alfalfa hay and rolled barley. The steers made an average daily gain of 1.53 pounds per head. This trial shows that silage may be made from weedy alfalfa which would make but inferior hay, that such silage will be eaten without waste, and that it can be used as a supplemental feed when fattening steers are fed alfalfa hay and barley.[20]

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[20] Alfalfa Silage for Fattening Steers, by Gordon H. True, F. W. Woll, and V. F. Dolcini. California Sta. Circ. No. 124, pp. 1–4.

OIL MEAL AS A FOOD FOR SKIM MILK-FED CALVES

The Division of Animal Husbandry concludes as a result of two trials that the addition of oil meal to the grain ration does not materially affect the gains made by skim milk-fed calves or the cost of the grains. Some advantage was noticed, however, as regards the thriftiness of the calves receiving the oil meal.

Sixteen calves separated into two even lots were fed a grain mixture of ground oats, ground barley and wheat middlings, two parts each by weight, during the period November 19, 1914, to January 28, 1915. One of the lots was fed one part of linseed meal in addition to the above mixture. From February 4 to April 1, 1915, twenty-four calves separated into three even lots of eight each were fed a grain mixture, one lot, three parts ground Milo maize and two parts rolled barley, and the other two lots, one of which was composed of younger calves, were fed the same mixture with one part of linseed meal added.

SOILING VERSUS PASTURING GRAIN-FED PIGS

The Division of Animal Husbandry has determined that the economy of soiling versus pasturing evidently depends on the cost of labor and on the location of the alfalfa field in relation to the hog pens. The same amount of barley was fed to two lots of fifteen hogs each. Each lot received the same amount of barley, but the soiling lot required 5 per cent more barley for a pound of gain than the pasture lot. However, only one-tenth of an acre was cut for soiling during a period of ten weeks, while four-tenths of an acre was used for pasturing. The pigs on pasture were larger framed when marketed, but not quite so fat as those from the soiling lot.

FEEDING ALMOND HULLS

True reports that the gains made by swine running to the piles of almond hulls are apparently due to the waste nut meats picked out from among the hulls and not to the hulls eaten. In order to secure definite information as to the feeding value of almond hulls, two trials, one with sheep and one with swine, were carried on by the Division of Animal Husbandry.

The pigs, when fed an exclusive ration of almond hulls, lost weight daily, but when given one pound of barley for each one hundred pounds live weight and one-half as many almond hulls as constituted a full ration of these alone a pound of gain was secured for each 10.26 pounds of hulls fed in addition to the barley.

The experiment with sheep covered a period of six weeks. Lot 1, three sheep, was fed almond hulls alone, and lot 2, four sheep, was fed almond hulls and alfalfa hay. After ten days of feeding, however, it was found necessary to add hay to the feed of lot 1, as the sheep were losing weight and finally refused to eat the hulls when fed alone. One pound of hay was fed per sheep per day. Lot 2 was given one-half pound of hay per day per sheep. The gains were unsatisfactory and could practically be accredited to the alfalfa hay alone.

MILCH GOATS

Three milch goats completed the year's records at the University Farm, as follows: Geneva, two-year-old pure Toggenburg, 2158.0 pounds of milk and 72.80 pounds of butter fat; Hedda, two-year-old Toggenburg, 1118.0 pounds of milk and 40.70 pounds of butter fat; Delia, yearling grade Toggenburg, 1283 pounds of milk and 49.73 pounds of butter fat. True reports the feed cost of one pound of milk from these goats was approximately 90 per cent that of one pound of milk of a similar average fat content produced by a group of five cows in the University dairy herd. One of the advantages to be derived from the use of goats for milk production is that they may be fed on roughage that on account of the small quantities produced would have no market value.

THREAD LUNG WORMS IN GOATS

An outbreak of Thread Lung Worms, or *Dictyocaulus filaria,* occurred in Marin County in August, 1914, among a recently purchased herd of 150 Angora goats. This particular species, which also attacks the sheep and deer, never has been reported before as epidemic in California. Ledyard, a post-graduate student in Parasitology, has submitted a thesis for the Master's degree upon this outbreak, after a careful study of nine months.

Part of the life-cycle of the parasite occurs outside the host. Ledyard kept embryos and ova alive in wet soil for three months. The infection, in the outbreak under observation, appears to have been due to a wet, marshy place on the ranch that had doubtless been infected by deer. An examination of the bronchial passages revealed the presence of these parasites, which are from 1.25 to 3.25 inches in length. Death appears to be caused through suffocation. The worm also occupies pockets in the nasal passages. Careful post-mortem examinations were made, but no worms were ever found in front of these pockets. Fumigants, tracheal injections and anthelmintics were found to be valueless as remedial measures. Ledyard has found that mature worms do not survive the vapors of chloroform longer than three and one-half minutes under laboratory conditions. An injection of one and one-half cubic centimeters (1½ c.c.) of chloroform into each nostril proved successful in eliminating a number of the worms and had no harmful effect on the host.

By means of chloroform, isolation and sanitary measures the epidemic was brought under control.

A NEW SPECIES OF LOUSE ON GOATS

In a study which Ledyard made of the Thread Lung Worm in goats it was found that the animals were seriously affected by lice. Specimens of this louse were sent to Professor Vernon L. Kellogg of Leland Stanford Junior University. He described it as a new species, which he has called *Trichodectes hermsi* (Kellogg), in honor of Professor W. B. Herms of this station. Like all other vermin of this sort, it was easily controlled by dipping with coal tar disinfectants, such as Kreso or some compound solution of cresol. The reduction in profits to stockmen on account of lice harbored by domestic animals is far greater than is usually recognized and is a loss that is comparatively easy to prevent.

KEEPING QUALITY OF BUTTER

Davis found that butter made in whole milk creameries has better keeping quality than that made in the average gathered-cream plant. Pasteurization of old cream does not insure good keeping quality in butter made therefrom. The average score of twelve cubes of fresh California June butter selected from an entry of the Educational Butter Scoring Contest was 92. After being held fifteen weeks it was 88½, thus showing considerable depreciation during storage.

INCUBATOR TEMPERATURES

Investigations by Dougherty indicate the best average temperature for an incubator is 102° F. when the bulb of the thermometer is on a level with the top and touching a fertile egg. If, however, the thermometer is above and not touching the eggs, the incubator should be started at a fairly high temperature and this temperature gradually lowered as the hatch progresses.

Three trials were made in which an incubator with a thermometer touching the eggs was compared with one where the bulb was one-half inch above the eggs. In these trials the thermometer on the eggs at the beginning of the hatch registered about 102° F., while in the other incubator the thermometer, one-half inch above the eggs, registered about 104° F. Toward the close of the hatch, however, both thermometers in each trial registered almost exactly the same, varying in different trials from 102° to 103° F.

ANIMAL PROTEIN FOR LAYING HENS

Dougherty found as a result of investigations covering a year that animal protein should be fed to laying hens to secure the best results. He also found that a good grade of fish scrap gave as good results as commercial meat scrap and when properly fed did not in any way taint the eggs laid.

A check pen of fifty, two- and three-year-old hens without high protein feed, laid 102.1 eggs per hen during the year. Pens of similar character and fed high protein in addition gave the following number of eggs per hen per year:

Soy bean meal	104.9
Meat scrap	129.7
Fish scrap	131.7

The following year five pens of thirty-three hens each were fed a grain ration consisting of a mixture of 150 pounds of whole wheat, 100 pounds of whole barley, and 50 pounds of cracked yellow Indian corn or whole Egyptian corn. They were also fed a so-called dry mash consisting of a mixture of 50 pounds of bran, 50 pounds of shorts, 5 pounds of fine charcoal and 1 pound of fine salt, to which were added either 30 pounds of meat scrap alone or 30 pounds of a high-protein ration consisting of a combination of meat scraps with soy bean meal or O. P. linseed meal. The average amount consumed per hen per year in the five lots was: grain 49½ pounds, and dry mash, 23½ pounds. The average number of eggs laid per hen was 142. The average cost per dozen of grain and mash consumed, 10½ cents. In this trial no advantage was found in a mixture of vegetable and animal protein over feeding animal protein alone. Buttermilk at 20 cents a hundred pounds was found to be a satisfactory and economical substitute for meat scrap at $3.25 per hundred pounds.

VACCINATION FOR CHICKEN POX

On July 1, 1914, investigations concerning roup, chicken pox and similar poultry diseases were undertaken by Beach of the Veterinary Division. Funds for this work were provided jointly by the United States Bureau of Animal Industry and this station. He has made a practical and successful application of the method of vaccination against chicken pox, which was devised by Hadley and Beach at the

Wisconsin Agricultural Experiment Station. In one flock badly infected at the time of vaccination a total of 1177 fowls were treated and only 9 per cent subsequently developed chicken pox lesions. In the same pens 121 fowls were left unvaccinated for controls, and 87½ per cent of these subsequently developed chicken pox. The vaccination appears to have a curative as well as a preventive value. Vaccine was given to 113 diseased fowls in addition to local treatment and 113 diseased fowls with lesions of the same degree of severity were given local treatment of the lesions only. The percentage mortality of the vaccinated lot was 25 per cent; of the unvaccinated lot 54 per cent. The average length of time required for recovery of the vaccinated lot, 14 days. The technique of this vaccination method is so simple that it is believed that poultry raisers will be able to prepare the vaccine and administer the treatment themselves.

BOVINE TUBERCULOSIS

The study of tuberculosis in domestic animals has been continued by the Division of Veterinary Science. Much remains to be learned concerning the transmission of the germs of tuberculosis from one animal to another. Our present knowledge of the subject indicates that practical methods of control of tuberculosis in domestic animals necessitates:

1. The isolation of young from mature animals.
2. The feeding of young animals on boiled or pasteurized milk.
3. The elimination of all mature animals showing physical signs of the disease.

The attempt to eradicate the disease in cattle by tuberculin testing and the slaughter of all reacting animals is impracticable as a state-wide policy. Individual owners whose herds contain 15 per cent or less of tuberculous animals may wisely practice this method, as should all breeders of pure-bred animals, since the distribution of pure-bred bulls may otherwise become a source of infection.

A really effective state-wide control of tuberculosis in domestic animals does not require the slaughter of affected animals which are otherwise in good health. Calves are so seldom born tuberculous that such means of transmission may be ignored, hence if all calves are kept free from the disease it would only require one generation of domestic animals to eradicate the tuberculosis. All constructive legislation should concern itself primarily with the young animals.

The lack of isolation, the feeding of milk containing tubercle germs, and the limited knowledge of the methods of transmission of the germs from one animal to another are the chief causes of the continuation of tuberculosis in domestic animals.

MASSAGING FOR THE INTRADERMAL TEST

The excellent results obtained by Traum in massaging the injected area in the intradermal tuberculin testing of guinea pigs, used in the experiments above, suggested that this added manipulation might prove a desirable adjunct to the intradermal tuberculin testing of cattle.

The intradermal test was given to 135 cattle, in which both subcaudal folds were injected with equal amounts of similar tuberculin, one fold being massaged. The results of these tests showed that massaging the area of tuberculin injection neither obviated nor decreased the reaction, but increased it in nine cases. In seven cases massaging showed a reaction on the treated fold, while the untreated fold gave practically negative results. These observations have demonstrated the impossibility of obscuring the test by rubbing out the swelling, at the point of injection, occurring in reacting animals. It appears that this procedure may improve the accuracy of the intradermal test.

THE ELIMINATION OF TUBERCLE BACILLI FROM BODIES OF CATTLE

Faeces and throat swabs from 36 cows (practically all tuberculin reactors) were examined by Traum for the presence of tubercle bacilli by means of guinea-pig inoculations. None of the faeces were proved to contain tubercle bacilli by this means, even though two of the samples were from cattle that showed lung lesions upon physical examination. Two of the 36 throat swabs were proved to contain tubercle bacilli. One of these two swabs was from a cow showing lung lesions upon physical examination, while the other was from a cow that failed to show any evidence of tuberculosis upon physical examination.

Antiformin was used in preparing the faeces for inoculation. That this is desirable was concluded from four series of experiments.

Eighteen samples of milk from the above cows showing no physical signs of tuberculosis were tested for presence of tubercle bacilli by guinea-pig inoculation. In none of the cases was any evidence of the presence of tubercle bacilli demonstrated. Of sixteen of these guinea pigs, which were chloroformed at eight weeks or later after inoculation, five showed infection with the bacteria causing infectious abortion in cattle.

THE IMMUNIZATION OF CALVES AGAINST TUBERCULOSIS

Of the seven calves immunized after the method of Pearson and Gilliland in 1913, five have been killed. One was found to have a tuberculous infection. In one the nature of the lesions was not determined. In three no lesions could be found. Two are still under observation.

Haring concludes that the methods of von Behring and the modifications used by Pearson and Gilliland not only fail to protect sufficiently to be of practical value but the Pearson and Gilliland method with Culture Ravenel M. is positively dangerous in that the vaccine may in some cases transmit bovine tuberculosis.

STABLES, CORRALS, PASTURE, AS A MEANS OF TRANSMITTING BOVINE TUBERCULOSIS

A dairy barn, corral and thirty-acre field became available, where a badly tuberculous herd had been kept and where several open cases of tuberculosis had occurred in the herd during the preceding year. On June 12, 1914, one month after the removal of all the infected herd—the mangers and water troughs being left unclean—when the farm was vacated;—the Division of Veterinary Science placed twenty-five non-reacting, healthy animals in the premises. After an interval of seventy days these cattle were tested, but none reacted at that time. Eleven of them were killed for beef, but no lesions could be found. The remainder have been retained on the premises. They were retested on December 14, 1914, and May 13, 1915, but no reactors had developed.

PREVALENCE AND PREVENTION OF HOG CHOLERA IN IMPERIAL VALLEY

Taylor reports that there is less cholera in Imperial Valley in relation to the number of hogs, at this time, than in previous years. In several cases where hog cholera had partially or entirely depleted herds, by the simultaneous application of proper method of sanitation, inaugurating a system of isolation, installing dipping facilities and making other necessary preparations for the proper handling of the animals, the industry has again been revived. In some cases it has been found that the use of serum can be materially lessened or abandoned entirely and the animals kept in a good healthy growing condition. There are a few centers of infection present in the valley in which cholera appears in a chronic form, and from such centers occasional cases of acute cholera arise in other herds through interchange of animals for breeding or feeding purposes.

In November, 1914, the Board of Supervisors of Imperial County enacted an ordinance requiring that all hogs shipped into the valley be either vaccinated by the simultaneous method some days prior to entry or held in quarantine twenty days after arrival. The results of this ordinance is clearly shown by the absence of new foci infection due to the shipping in of feeders, as in former years.

DERMATITIS IN HORSES

Dermatitis, a skin disease in horses, occurs in Imperial Valley primarily during hot weather, but in several cases it apparently becomes chronic, existing the year round. Taylor reports that there are two main contributing factors in this disease; these are lack of grooming and exceeding dryness of the atmosphere. In all cases studied the affected parts were situated either at a point where sweat and lather from work is allowed to accumulate or at a point upon the body where it is impossible for the animal to rub or scratch the part. In well groomed animals this condition has not been found. Grooming with a stiff brush acts at once as massage to the parts and at the same time removes the dried and crusted perspiration. Under a proper amount of grooming affected animals improve. Numerous preparations have been tried and it seems that some agent containing a bland oil which will loosen the skin and overcome the dried condition is beneficial. Excellent results have been obtained by the application of the following preparation:

Salicylic acid	4 oz.
Creolin	4 oz.
Liquid pitch	4 oz.
Sublimated sulphur	2 oz.
Cotton seed oil	1 pt.

Remove the dried scurf by the use of a stiff vegetable brush and green soap, apply mixture and repeat in two days.

DEMODECTIC MANGE IN PIGS

A skin disease in pigs known locally as smallpox occurs in Imperial Valley, which while not fatal causes considerable annoyance and injury.

Taylor has demonstrated the presence in the hair follicles of the affected animals of the parasite *Demodex folliculorum* (suis). This is undoubtedly the primary cause of the irritation giving rise to papules, which later become infected with *Bacillus necrophorus,* causing local sloughing of restricted areas and pit formation. Dipping in a 2 per cent compound cresol solution with water greatly relieves the condition, destroying the bacillus necrophorus on the surface. Measures looking toward the general health of animals enables them to overcome the invasion by the Demodex.

PROBLEMS FOR INVESTIGATION

There are relatively few scientific workers in those parts of the world where the climate is arid and agriculture is conducted either with or without irrigation. The workers of this station have little to guide them in their researches and there is comparatively little knowledge gained elsewhere which can safely be applied to California conditions without first submitting it to demonstration here.

California has an area equal to the nine North Atlantic states, which have ten federal and state stations, and has a climatic range as great as the thirteen original colonies. There is scarcely a crop grown commercially anywhere in continental United States which is not grown in California. The problem of each, as to variety, culture, insect pests, fungus diseases, methods of harvesting and marketing must be the constant concern of the station. Furthermore, the industries are highly specialized, which, like all specialized industries, develop unusual and particular problems. There is even a greater segregation of domestic animals than in most states, which, if not really creating different problems, accentuates in a marked degree those occurring elsewhere.

Thus it is that the station workers are constantly induced to undertake too many problems only to find that time, strength and facilities will not permit of satisfactory progress on all of them.

During the past two years 366 projects have been outlined. During the year some progress has been reported on 133 of them. Below is the list of those on which progress has been reported.

No. 16. A Systematic Study of the Important, So-called Physiological Diseases of Plants Occurring in California. By Ralph E. Smith, S. S. Rogers, Wyatt W. Jones and A. Boncquet, reporting to Ralph E. Smith; at Berkeley and various field stations; Van Nuys and Roosevelt (Internal Brown Streak of Potato); Oroville (Exanthema); Stockton and vicinity (Little Leaf). Begun July 1, 1913.

No. 23. The Intradermal Tuberculin Test for Detecting Tuberculosis in Cattle. By C. M. Haring and Jacob Traum, reporting to C. M. Haring. Begun June 14, 1913.

No. 24. A Study of Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California. By C. M. Haring, C. L. Roadhouse and Jacob Traum, reporting to C. M. Haring; at Berkeley and elsewhere in California. Begun January 2, 1914.

No. 25. A Chemical, Biological and Physiological Study of Alkali in Soils, in its Relations with Crop Production. By L. T. Sharp, reporting to Charles B. Lipman; at Davis, Berkeley, Kearney Park. Begun August, 1913.

No. 28. A Continuation of Past Studies on the Lime-Magnesia Ratio for Plants, Particularly Oranges. By W. F. Gericke, reporting to Charles B. Lipman. Begun August, 1911.

No. 30. Fundamental Studies on the Antagonism between Salts as Measured by Bacterial Efficiency in Soils. (Continuation of past studies.) By P. S. Burgess, reporting to Charles B. Lipman. Begun December, 1908.

No. 31. Determination of the Amounts of Nitrogen Fixed by Leguminous Cover Crops in California, Particularly in Orchards. By W. F. Gericke, reporting to Charles B. Lipman; at Davis and co-operatively in other orchards. Begun November, 1913.

No. 32. A Study of the Bacterial Flora of Soils on which Dieback in Citrus Trees Occurs, to Determine whether or not any Relation Exists between the Bacterial Flora of the Soil and the Diseased Condition. By P. S. Burgess, reporting to Charles B. Lipman. Begun July, 1914.

No. 34. Co-operative Experiments in the Control of Bovine Tuberculosis. By Jacob Traum, reporting to C. M. Haring; at Berkeley and elsewhere in California. Begun August 8, 1913.

No. 39. Toxicity of Insecticides; (*b*) Physical Variations: Strength of Tent Material to Determine Specifications for Weavers which will give Best Compromise between Strength and Tightness. By C. W. Woodworth.

No. 51. Reclamation of Alkaline Lands by Flooding and Tile Drainage. Work done co-operatively by the Division of Soil Technology, University of California, and the Division of Drainage Investigations, Office of Experiment Stations, United States Department of Agriculture, at Fresno, California, SE ¼, Sec. 6, T. 148, R. 19 E. By C. F. Shaw and W. W. Weir, reporting to Charles F. Shaw. Begun June 9, 1913.

No. 52. Hog Cholera: Its Prevalence and Prevention in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Begun February, 1914.

No. 54. Miscellaneous Investigations Concerning Live Stock Losses in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring. Begun February, 1914.

No. 61. Certified Dairy Inspections. By C. L. Roadhouse and G. K. Cooke, reporting to C. M. Haring; at various certified dairies. Begun January 1, 1914.

No. 62. Tuberculin Testing of Cows in Certified Dairies. By C. L. Roadhouse, reporting to C. M. Haring. Begun March, 1914.

No. 63. Bacteriological Examinations of Certified Milk. By C. L. Roadhouse and others, reporting to C. M. Haring. Begun January, 1914.

No. 64. Drainage of Irrigated Lands by Pumping from Sump, without Tile. By W. W. Weir and L. K. Marshall, reporting to Chas. F. Shaw; work located at Fresno, California, Experiment Station Tract. Begun September 30, 1913.

No. 65. A Study of the Effects of Liming and Inoculating Lima Bean Soils of Santa Barbara County on the Yield and Protein Content of Lima Beans. By Charles B. Lipman; at Stow Ranch, near Goleta, and Dixey Thompson Ranch, about four miles from Santa Barbara. Begun February 1, 1913.

No. 70. A Feeding Experiment to Determine the Value of Ground Barley as a Supplement to Alfalfa in the Feeding of Dairy Cows. By E. C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Begun August 6, 1913.

No. 72. Studies Concerning Infectious Abortion. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Suggested June 14, 1913.

No. 73. Investigation to Find the Relative Values of Soy Bean Meal, Meat Scrap, Buttermilk, and O. P. Linseed Oil Meal as High Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty; at University Farm, Davis. Begun November 15, 1913.

No. 74. Comparative Grading of Butter on the San Francisco and Los Angeles Markets. By L. M. Davis. Begun June 30, 1913.

No. 75. The Keeping Quality of Butter. By L. M. Davis. Begun June 30, 1913.

No. 78. Variety Trials of Grain. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Begun January, 1914.

No. 79. Crop Production and Soil Management in Relation to Climatic Conditions in Imperial Valley. By Walter E. Packard, reporting to J. W. Gilmore; at Imperial Valley. Begun January, 1914.

No. 81. Rotations. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Begun January, 1914.

No. 82. Crop Production and Soil Management in Relation to Soil Type at Imperial Valley Station. By Walter E. Packard, reporting to J. W. Gilmore. Begun January, 1914.

No. 83. Manure Experiments. By Walter E. Packard, reporting to J. W. Gilmore. Begun June, 1914.

No. 89. Walnut-Oak Hybrids; Study of a New Form of *Juglans Californica;* Teratology in *Juglans Californica;* Allied Problems. By E. B. Babcock. Begun March, 1908.

No. 91. Metabolism of Fresh Milch Cows. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Begun December, 1913.

No. 92. A study of the Effects of Alfalfa as Exclusive Food in the Development of the Dairy Calf and Heifer for Dairy Purposes. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True. Begun March, 1914.

No. 94. Breeding Experiments with Bulbous Plants. By E. B. Babcock and H. E. Gilkey. Begun November, 1912.

No. 96. Improvement of Bearing of Vine Varieties by Selection. By F. C. H. Flossfeder, reporting to Frederic T. Bioletti. Begun 1910.

No. 98. Resistant Stocks for Californian Vines. By F. C. H. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 103. Relation of Degree of Maturity of Grapes to Quantity and Quality of Raisins. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun August, 1913.

No. 104. Resistant Stocks for Raisin Varieties. By A. E. Way, reporting to Frederic T. Bioletti; at Kearney. Begun 1911.

No. 106. Varieties and Methods Suitable for Grape Growing in the Imperial Valley. By W. E. Packard, reporting to Frederic T. Bioletti; at University Experiment Station, Imperial. Begun 1911.

No. 108. Coatings for Cement Wine Vats. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun January, 1913.

No. 110. Improvement of Methods of Preparing Unfermented Grape Juice. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1913.

No. 111. Standards of Composition of California Grapes and Wine. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun December, 1913.

No. 112. Improvement of the Methods of Vinegar Making in California. By W. V. Cruess, reporting to Frederic T. Bioletti; at Berkeley, Watsonville, Sebastopol, etc. Begun September, 1912.

No. 114. Preparation of Collection of Olive Trees at Davis, Kearney and Imperial and of Specimens at Berkeley. By W. F. Oglesby, reporting to Frederic T. Bioletti; at Berkeley and Davis. Begun March, 1913.

No. 115. Improvement of Methods of Pickling Olives. By W. F. Oglesby, reporting to Frederic T. Bioletti. Begun December, 1913.

No. 118. A Study of Bacterial Disease of Olives known as Olive Knot with the Purpose of Discovering the Method of Dissemination of the Causative Organism and the Conditions Governing Inspection, the Perfecting of a Practical Method of Control or Eradication and Study of the Pathological Changes Connected with the Knot Formation. By W. T. Horne, reporting to Ralph E. Smith; at Berkeley and Fair Oaks. Former Plant Pathology Project No. 10 commenced in previous years.

No. 119. Improvement of the Walnut Industry, Based Particularly Upon Control or Avoidance of Blight and Other Diseases. By Ralph E. Smith and S. S. Rogers, reporting to Ralph E. Smith; in various parts of the state. Continuation of previous investigations.

No. 120. Demonstration of Improved Methods of Enology. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun January, 1914.

No. 124. Studies of the Feed Requirements and Milk Production of Milch Goats: (*a*) on the Value of Grain Feeds for Goats Fed Alfalfa Hay. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True, University Farm, Davis. Begun February, 1914.

No. 157. Investigation to Find the Relative Effects of Different Degrees of Temperature on the Number and Quality of the Chicks Hatched in Incubators and Reared to Four Weeks of Age. By J. E. Dougherty; at Davis. Begun January, 1914.

No. 158. The Pollination of Domestica and Triflora Plums Under California Conditions. By A. H. Hendrickson, reporting to A. V. Stubenrauch. Location of the work at Davis, and commercial orchards in representative sections of the State. Begun January, 1914.

No. 159. Student Laboratory Plantings—A Study of Fruit Tree Stocks, Pruning and Planting Methods. By members of the teaching staff, reporting to A. V. Stubenrauch; at University Farm, Davis. Begun November, 1913.

No. 160. Death of Animals and Cases of Serious Sickness at University Farm. By F. M. Hayes, reporting to H. E. Van Norman. Begun January 9, 1914.

No. 161. Weekly Report of Work in Progress at University Farm by Farm Division, Repairs and Power Division and Grounds. By T. Tavernetti, reporting to H. E. Van Norman. Begun January, 1914.

No. 163. Reconnaissance Soil Survey of Sacramento Valley Area, California. By J. W. Nelson and party, reporting to C. F. Shaw; Sacramento Valley, California, from Red Bluff south, below Suisun Bay (from 38° to 40° 15′ N) and from the foothills on the west of the hills on the east. Begun July 1, 1913.

No. 164. Soil Survey of Southern California. By J. W. Nelson and party, reporting to C. F. Shaw; Southern California between the Pacific Ocean and the 116° 30′ W meridian and between the Mexican boundary and 30° 30′ N parallel of latitude. Begun February 1, 1914.

No. 165. Soil Survey of the Bay Region, California. By J. W. Nelson and party, reporting to C. F. Shaw. Between Santa Rosa on the north and Santa Cruz on the south, the ocean on the west and the great valleys on the east. Begun May, 1914.

No. 172. The Value of Supplementary Feeds in Conjunction with Alfalfa Pasture for Pork Production. By J. I. Thompson and E. C. Voorhies, reporting to Gordon H. True. Begun August 25, 1914.

No. 173. Fertilizer Experiment. By B. A. Madson, reporting to J. W. Gilmore; University Farm, Davis. Continuation of work of several years past.

No. 174. Rotation Experiments. By B. A. Madson, reporting to J. W. Gilmore; at University Farm, Davis. Begun November, 1913.

No. 175. Seed Exchange Experiment. By B. A. Madson, reporting to J. W. Gilmore. Continuation of work begun in 1907.

No. 176. Variety Trials with Wheat, Barley and Oats in Plots. By B. A. Madson, reporting to J. W. Gilmore. Continuation of work carried on for a number of years.

No. 177. Soiling vs. Pasturing as Supplements to the Grain Ration of Hogs. By J. I. Thompson, reporting to Gordon H. True. Begun February, 1914.

No. 179. Comparative Cost of Hand Milking vs. Machine Milking in Commercial Dairies. By Edwin C. Voorhies, reporting to Gordon H. True. Begun March, 1914.

No. 182. Investigation of the Nature and Commercial Value of the Proximate Principles and Distillation Derivatives Present in the Principal Varieties of California Kelps. By D. R. Hoagland and others, reporting to John S. Burd. Begun January 1, 1914.

No. 184. Maintenance of Forage Supply in the Mountain Regions of California. By P. B. Kennedy, reporting to J. W. Gilmore. Begun March, 1914.

No. 186. The Practicability of Growing Vegetables on the University Farm. By S. S. Rogers, reporting to H. E. Van Norman; University Farm, Davis. Begun January 1, 1914.

No. 187. Almond Culture. By R. H. Taylor, reporting to A. V. Stubenrauch. Work carried on at the University Farm, Davis, and commercial orchards in representative districts. Begun April, 1914.

No. 189. Reduction in Scale and Grade of Lumber in Yard. Study to be made in co-operation with the Forest Service, U. S. Department of Agriculture. By M. B. Pratt, reporting to Walter Mulford. Begun May, 1914.

No. 190. Cross-Breeding Peaches with Reference to (1) Improved Fruits, (2) Improved Root Stocks, (3) Study of Inheritance in Amygdalus. By E. B. Babcock, R. E. Clausen and others, reporting to E. B. Babcock. Begun February, 1909, at Whittier; 1914 at Berkeley.

No. 191. A Study of the Fertilizer Requirements of Citrus Fruits. By H. J. Webber, W. M. Mertz and others; at the Citrus Experiment Station, Riverside. Begun April, 1907.

No. 192. Green Manure Crops for Southern California, with Special Reference to their use in Citrus Orchards. By W. M. Mertz, reporting to H. J. Webber; at Citrus Experiment Station, Riverside. Begun September 1, 1909.

No. 193. The Effect of Different Stocks on Commercial Species and Varieties of Citrus. By W. W. Bonns and W. M. Mertz, reporting to H. J. Webber. Series 1, Citrus Experiment Station, Riverside; Series 2, new site of Citrus Experiment Station and elsewhere as nature of work proves desirable. Begun April, 1907.

No. 194. A Study of the Varieties of Citrus Fruits and Their Relatives. By H. J. Webber, M. W. Mertz, H. B. Frost and others, reporting to H. J. Webber. Citrus Experiment Station, Riverside. Begun February 1, 1913.

No. 197. Study of the Comparative Infectiousness of the Crown Gall Organism (*Bacterium tumefaciens*), with Special Reference to Finding Resistant Forms of Prunus Suitable as a Root Stock for the Various Stone Fruits. By C. O. Smith, reporting to H. J. Webber. Work carried on at Whittier. Begun March, 1910.

No. 198. Lemon Decay Fungi, with Special Reference to Their Control by Wash Water Disinfection. By C. O. Smith and E. E. Thomas, reporting to H. J. Webber. Work carried on at Whittier, California, as headquarters, with experiments and observation over all of Southern California. Begun April 8, 1911.

No. 202. Investigation to Determine Cause or Causes of the Spotted Growth in Barley Fields—Some Extremely Good, Some Very Poor. By C. B. Lipman and P. S. Burgess, reporting to C. B. Lipman. Begun March, 1914.

No. 250. Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and Other Fruit Trees. By H. S. Fawcett, reporting to H. J. Webber. Work carried on at Whittier, Santa Paula, Chula Vista, Riverside and other places. Begun February, 1912.

No. 251. Investigations as to the Cause and Treatment of Melaxuma of English Walnut Trees. By H. S. Fawcett, reporting to H. J. Webber. Begun June, 1913.

No. 252. Routine Examination of Material Sent to the Citrus Experiment Station, and Minor Studies in Mycology and Bacteriology. By J. T. Barrett, C. O. Smith and H. S. Fawcett, reporting to H. J. Webber; work carried on at Riverside and Whittier. Begun 1909.

No. 258. The Nematode Problem on Citrus Trees. By E. E. Thomas, reporting to H. J. Webber; work carried on at Whittier, Riverside and various points in Southern California. Begun December, 1912.

No. 265. Citrus Survey. By C. S. Milliken and A. R. Tylor, reporting to H. J. Webber at the Citrus Experiment Station, Riverside. Begun April 6, 1914.

No. 269. The Influence of Barley on the Milk Secretion of Cows. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. Begun July, 1913.

No. 270. Improvement of Wheat, Barley and Oats by the Centgener Method. By B. A. Madson, reporting to J. W. Gilmore. Begun March, 1914.

No. 271. Triangular Soil Exchange Experiment. By B. A. Madson, reporting to J. W. Gilmore. Begun November, 1913.

No. 272. Variety Trials with Field Peas and Eight Vetches. By B. A. Madson, reporting to J. W. Gilmore. Begun February, 1914.

No. 273. Variety Trials with Wheat, Oats and Barley in Rows. By B. A. Madson, reporting to J. W. Gilmore. Begun February, 1914.

No. 275. A Study of the Milk and Cream Supply Furnished to University Farm Creamery, University Farm, Davis, with the Object of Working Out a System of Grading and Paying for Quality. By H. H. Douglass, reporting to L. M. Davis. Begun July, 1914.

No. 281. Cultural Experiments with Cotton. By W. E. Packard, reporting to J. W. Gilmore. At Imperial Valley Experiment Station. Begun August, 1913.

No. 282. Sudan Grass Experiment. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1913.

No. 283. Experiments with Non-Saccharine Sorghums, Saccharine Sorghums and Broom Corn. By B. A. Madson, reporting to J. W. Gilmore. Begun May, 1914.

No. 284. Corn Experiments. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1914.

No. 285. Potato Experiments. By B. A. Madson, reporting to J. W. Gilmore. Begun May, 1914.

No. 286. Bean Experiments. By B. A. Madson, reporting to J. W. Gilmore. Begun February, 1914.

No. 287. Culture Experiments with Cowpeas and Soy Beans. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1914.

No. 289. Improvement of Corn and Sorghum by Selection. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Begun April, 1914.

No. 293. Studies in Jelly Making. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1914.

No. 294. Use of Tannin in White Wine Making. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1914.

No. 295. Studies of Methods of Chemical Analysis of Wine. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1914.

No. 296. Effect of Low Temperatures of Sterilization on Quality of Canned Fruits. By W. V. Crues, reporting to F. T. Bioletti. Begun August, 1914.

No. 297. Collection of Data to Aid in the Establishment of Standards for Wine, Raisin and Shipping Grapes. By F. T. Bioletti. Begun August 8, 1914.

No. 298. Investigation of Live Stock Conditions and Losses in Southern Solano County for the Selby Smelter Commission. By C. M. Haring, reporting to Selby Smelter Commission. Begun October 28, 1913.

No. 302. A Study of the Value of Cooling Immediately after Drawn, Milk which is to be Held Over Night for Cheese Making the Following Day. By H. S. Baird, reporting to L. M. Davis. Begun November, 1914.

No. 303. A Study of Date Seedlings of Known Parentage Reared from Cross-Pollinated Seed. By J. Eliot Coit and Walter E. Packard; at Meloland and Berkeley. Begun April, 1908.

No. 306. Agronomical Seed Collection. By P. B. Kennedy, reporting to J. W. Gilmore. Begun March, 1914.

No. 307. Agronomical Plant Collection. By P. B. Kennedy, reporting to J. W. Gilmore. Begun January, 1914.

No. 309. Composition and Carrying Capacity of Veterinary Pasture North of Campus, Berkeley. By P. B. Kennedy, reporting to J. W. Gilmore. Begun March, 1914.

No. 310. Experiments in the Field Production of Anti-Hog Cholera Serum. By Walter J. Taylor, reporting to J. W. Gilmore; at Imperial Valley. Begun September 22, 1914.

No. 311. Investigation to Find the Relative Values of Meat Scrap, Digested Tankage, Blood and Bone Meal, Soy Bean Meal, O. P. Linseed Meal, Cocoanut Oil Cake Meal, and Alfalfa Meal as Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty. Begun December, 1914.

No. 312. Investigation of Roup (Avian Diphtheria) and Chicken Pox (Epithelioma Contagiosum). By J. R. Beach, reporting to C. M. Haring. Begun July 1, 1914.

No. 313. A Report of Inquiries from Poultry Raisers of California in Regard to Outbreaks of Disease among Their Flocks. By J. R. Beach, reporting to C. M. Haring. Begun June 22, 1914.

No. 314. Co-operative Extension Work in the Prevention of Hog Cholera in Co-operation with the U. S. Department of Agriculture. By members of the Veterinary Division in co-operation with Dr. B. J. Cady. Begun September 25, 1914.

No. 315. Investigation of the Possibility of the Extensive Feeding of Alfalfa Being a Cause of Barrenness. By C. M. Haring. Begun September, 1914.

No. 316. On the Value of Silage from Saccharine and Non-Saccharine Sorghums for Fattening Sheep on Alfalfa. By R. F. Miller, reporting to Gordon H. True. Begun December, 1914.

No. 317. Studies of Calf Feeding Problems with Special Reference to California Conditions. (1) On the Value of Oil Meal in Grain Mixtures for Skim Milk Calves. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. Begun October, 1914.

No. 318. The Health of Young Calves as Influenced by Various Systems of Feeding. By C. L. Roadhouse, assisted by J. N. Fulmore and F. E. Gillam. Begun August 17, 1914.

No. 319. Cost of the Manufacture of Olive Oil and Pickles in California. By W. F. Oglesby, reporting to F. T. Bioletti. Begun December, 1914.

No. 320. A Study of the Control of Mould Development in the Cheese Curing Rooms, Dairy Building, University Farm, Davis. By H. S. Baird, reporting to L. M. Davis. Begun December, 1914.

No. 321. Unfermented Orange Juice. By W. V. Cruess, reporting to F. T. Bioletti. Begun December, 1914.

No. 322. A Study of Methods of Making Glace Fruits. By W. V. Cruess, reporting to F. T. Bioletti. Begun December, 1914.

No. 324. Unfermented Lemon Juice. By. W. V. Cruess, reporting to F. T. Bioletti. Begun December, 1914.

No. 326. Ratio of Balling-Alcohol-Sugar in a Fermenting Grape Must. By W. V. Cruess, reporting to F. T. Bioletti. Begun December, 1914.

No. 327. A Study of Mould Development on Butter Sent to the University Farm by X Creamery. By L. M. Davis. Begun December, 1914.

No. 328. A Study of the Factors Affecting Swell in Ice Cream. By H. S. Baird, reporting to L. M. Davis. Begun March, 1915.

No. 329. To Determine the Relative Value of Alfalfa in Different Forms, as a Supplement to Barley for Pork Production. By J. I. Thompson and E. C. Voorhies, reporting to Gordon H. True. Begun December, 1914.

No. 330. Study of the Underlying Factors Influencing Soil Fertility as Evidenced by the Chemical Composition of the Soil Solution. By G. R. Stewart and others, reporting to J. S. Burd. Begun December 15, 1914.

No. 331. On the Value of Milo Silage as a Supplement to Alfalfa Hay for Dairy Cows. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. Begun January, 1915.

No. 332. Methods of Preparing Fruit Juices. By W. V. Cruess, reporting to F. T. Bioletti. Begun January, 1915.

No. 336. A Study of the Chemical and Physical Effects of Nitrate of Soda on Citrus Soils. By W. P. Kelley; at Citrus Experiment Station, Riverside. Begun November, 1914.

No. 340. A Study of California Butter. By L. M. Davis. Begun March 1, 1915.

No. 342. Soil Survey of the Ukiah Area. By E. B. Watson and R. L. Pendleton, reporting to C. F. Shaw. Begun May 20, 1914.

No. 343. Soil Survey of the San Fernando Area. By J. W. Nelson, L. C. Holmes and party, reporting to C. F. Shaw. Begun February 1, 1914.

No. 344. Soil Survey of the Honey Lake Area. By J. E. Guernsey and party, reporting to C. F. Shaw. Begun May 7, 1914.

No. 345. Soil Survey of the Pasadena Area. By E. C. Eckman and C. J. Zinn, reporting to C. F. Shaw. Begun March 1, 1914.

No. 346. Soil Survey of the San Bernardino Area. By J. E. Dunn and R. L. Pendleton, reporting to C. F. Shaw. Begun December 1, 1914.

No. 347. Soil Survey of the Los Angeles Area. By J. W. Nelson, L. C. Holmes and party, reporting to C. F. Shaw. Begun January 1, 1915.

No. 349. A Study of the Birth Weights and Rate and Cost of Gain from Birth to Weaning of Lambs from Ewes of Different Ages and Breeds. By Robert F. Miller, reporting to Gordon H. True. Begun February, 1915.

No. 350. No. 350. Utility of Winter Spraying in the Control of Vine Mildew. By F. C. H. Flossfeder, reporting to F. T. Bioletti. Begun January, 1915.

No. 351. Experiment in the Management of Old Groves. By H. J. Webber, W. P. Kelley, W. M. Mertz and others, reporting to H. J. Webber. Begun January, 1915.

No. 352. A Study of the Fumigation Process with Special Reference to the Chemical Problems Involved. By H. J. Quayle, H. D. Young and A. R. Tylor; at Whittier and Riverside. Begun September 1, 1914.

No. 353. Spraying for Insect Pests on Citrus and Olive Trees. By H. J. Quayle, A. R. Tylor and C. P. Clausen; in Tulare County and Southern California. Begun May 1, 1914.

No. 354. The Mealy Bugs of Southern California. By C. P. Clausen, reporting to H. J. Quayle. Begun May 1, 1914.

No. 355. A Comparative Study of *Coccus citricola* Campb. and *Coccus hesperidum* Linn. By H. J. Quayle. Begun January 1, 1915.

No. 356. A Study of the Life History and Economics of the Scale and Aphid Feeding Coccinellids. By C. P. Clausen, reporting to H. J. Quayle. Begun March 1, 1915.

No. 358. Injection of Cyanide Salts in Citrus Trees for the Control of Scale Insects, and of Blackleaf 40 per cent in Walnut Trees for the Control of the Walnut Aphis. By H. J. Quayle and A. R. Tylor. Begun April, 1915.

No. 359. The Use of the Fungus Isaria in Controlling the Black Scale. By H. J. Quayle and A. R. Tylor. Begun April, 1915.

No. 361. Survey of Situation of the Citrus Products and By-Products Industries in Southern California. By C. S. Milliken and R. S. Vaile, reporting to H. J. Webber. Begun September 25, 1914.

No. 362. Inheritance of Quantitative Characters in Tobacco. By R. E. Clausen, reporting to E. B. Babcock. Begun May, 1913.

No. 363. Strawberry Breeding. By R. E. Clausen, reporting to E. B. Babcock. Begun July, 1914.

No. 364. Minor Breeding Investigations. By E. B. Babcock, R. E. Clausen and others. Begun July, 1913.

BULLETINS AND CIRCULARS

During the year there have been published twelve bulletins and thirteen circulars, of which 400,000 copies have in the aggregate been distributed. In accordance with law, they are sent free upon request to any citizen of the state. The number, title and author are stated below:

Bull. 245. Commercial Fertilizers. J. S. Burd.
Bull. 246. Vine Pruning in California, Part II. F. T. Bioletti.
Bull. 247. Some Measuring Devices Used in the Delivery of Irrigation Water. Cal. Agents of Irrigation Investigations, Office of Experiment Stations, U. S. Dept. of Agriculture.
Bull. 248. The Economic Value of Pacific Coast Kelps. J. S. Burd.
Bull. 249. Stock Poisoning Plants of California. H. M. Hall and H. S. Yates.
Bull. 250. The Loquat. I. J. Condit.
Bull. 251. The Utilization of the Nitrogen and Organic Matter in Septic and Imhoff Tank Sludges. C. B. Lipman and P. S. Burgess.
Bull. 252. The Deterioration of Lumber. M. B. Pratt.
Bull. 253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California. R. D. Robertson and J. W. Nelson.
Bull. 254. The Avocado. I. J. Condit and M. E. Jaffa.
Bull. 255. The Citricola Scale. H. J. Quayle.
Bull. 256. The Value of Barley for Cows Fed Alfalfa. G. H. True, F. W. Woll and E. C. Voorhies.
Cir. 119. Winery Directions. F. T. Bioletti.
Cir. 120. Potato Growing in the San Joaquin and Sacramento Deltas of California. W. V. Shear.
Cir. 121. Some Things the Prospective Settler Should Know. Thomas Forsyth Hunt and other members of the staff.
Cir. 122. The Management of Strawberry Soils in the Pajaro Valley and its Problems. C. B. Lipman.
Cir. 123. Fundamental Principles of Co-operation in Agriculture. G. Harold Powell.
Cir. 124. Alfalfa Silage for Fattening Steers. G. H. True, F. W. Woll and V. F. Dolcini.
Cir. 125. Aphids on Grain and Cantaloupes. C. W. Woodworth.
Cir. 126. Spraying for the Grape Leaf-Hopper. H. J. Quayle.
Cir. 127. House Fumigation. C. W. Woodworth.
Cir. 128. Insecticide Formulas. C. W. Woodworth
Cir. 129. The Control of Citrus Insects. H. J. Quayle.
Cir. 130. Spraying for Walnut Aphis. A. R. Tylor.
Cir. 131. Cabbage Growing in California. S. S. Rogers.
Cir. 132. When to Vaccinate Against Hog Cholera. C. M. Haring.

SCIENTIFIC AND OTHER PAPERS

Usually advances in knowledge are made by slow degrees, often so imperceptibly as to make it impossible to assess the value or place proper credit. Discovery of the cause of pear blight, for example, was impossible until high-power microscopes were invented. Microscopes could not be invented until the science of optics had been developed, nor until scientific advances in the manufacture of cutting tools had been made. There are many processes of a most exact character that must be known before investigations in bacteriology can be made, such as the preparation and care of suitable materials for growing the organisms and methods of staining them. Those who are immediately interested in pear blight, its causes and its control, are not necessarily interested in the science of optics, nor in the refinements of the processes of the manufacture of cutting tools, nor in the chemicals required to stain the bacteria. So it is with every branch of scientific investigation. It is necessary to discover and develop new technical methods. The investigator who is most successful in discovering and developing such methods is usually the man who goes the farthest and deepest into fundamental things. It widens his and, afterwards, our horizon. To stimulate such researches, the results are published and distributed among scientific men and others. Hence many monographs, papers and articles are published which are often only of slight direct interest to the general public, and yet of the profoundest importance in the development of knowledge.

The staff of this station has been especially prolific in the preparation of such papers during the year. There are listed below something over eighty papers, detailing technical and, in some instances, more generally usable information, which have resulted from the researches of this station and which have been published in scientific journals and other publications apart from the station bulletins and circulars. They are arranged below alphabetically by authors, with an occasional comment on the results obtained.

SCIENTIFIC PAPERS

E. B. BABCOCK

Studies in Juglans II. Further Observations on a New Variety of *Juglans californica* Watson and on Certain Supposed Walnut-Oak Hybrids. Univ. of Cal. Publ. Agr. Sci., Vol. 2, No. 2.

A New Walnut. Jour. Heredity, Vol. 6, No. 1.

Frederic T. Bioletti

"L'Importanza della Cultura dell'Ullivo in California ed il suo, Avenire." Il Monitore Californiano, July, 1914.

Brief popular review of the past, present and probable future of the olive industry in California.

"The Wine Districts and Wine Grapes of California." In Statistical Report of the California State Board of Agriculture for 1913, pp. 154–156.

Discussion of the characteristics of the various wine districts and wine grapes of California.

"L'Industrie enologique en Californie." Bul. mensuel des renseign. agricoles. Institut international d'Agriculture, Rome, Feb., 1915.

Discussion of the present status of the wine industry in California.

"Amelioration and Sophistication of Wines." American Wine Press, March, 1915. (Read at the annual meeting of the American Wine Growers' Association, New York, Feb. 24, 1915.)

Discussion of what should be considered legitimate and what forbidden in legal regulations of wine making. The attempt was made to show that certain present legislation is undesirable, as it prevents certain practices whose only object is the improvement of the product.

J. E. Coit

"The Orange in California," "Lemon Culture in California," and "The Pomelo in California." Three articles in the Standard Cyclopedia of Horticulture, edited by L. H. Bailey.

"Citrus Fruits," a textbook on the California citrus fruit industry. Published by the Macmillan Company, New York, 503 pages, 151 illustrations.

"The Value of Careful Handling of Citrus Fruits." California Cultivator, March 18, 1915.

"Notes on Orange Testing." California Home and Farmer, May 1, 1915.

"The Pistachio Nut in California." California Cultivator, May 20, 1915.

W. V. Cruess

"Chemistry of the Olive." Univ. of Cal. Jour. of Agr., Feb., 1915, pp. 163-168.

"Unfermented Apple Cider." Better Fruit, Oct., 1914, pp. 31–34.

"Notes on Unfermented Lemon Juice." California Cultivator, Jan. 12, 1915, pp. 67–68.

"Unfermented Lemon Juice." Pacific Rural Press, Jan. 28, 1915, p. 102.

"Orange Jelly Making." Pacific Rural Press, May 1, 1915.

"Notes on Cost of Canning." California Cultivator, April 29, p. 513.

W. V. Cruess and J. E. Quiroga

"Jelly from Citrus Fruits." California Cultivator, Jan. 28, 1915, pp. 100-101.

W. V. Cruess, J. R. Zion, and A. V. Siefredi

"The Utility of Sulfurous Acid and Pure Yeast in Cider Vinegar Manufacture." Jour. of Industrial and Engineering Chemistry, April, 1915, pp. 324–325.

J. E. Dougherty

"Housing Problems as Met with in Semi-Arid Climates such as California." Jour. Amer. Assoc. of Instructors and Investigators in Poultry Husbandry, Vol. 1, No. 5.

Summing the question up very briefly, the type of house best suited to California conditions is one that can be made airy and cool during the hot days of summer, will keep out the strong winds and heavy rains of winter, will provide dry, comfortable, well protected scratching space where fowls may scratch and exercise in stormy weather, is comfortable for the fowls, is simple in construction and low in cost.

E. O. ESSIG

"Injurious and Beneficial Insects." Second edition. Supplement to Monthly Bull. Cal. State Comm. of Hort., Vol. IV, No. 4, 1915, lxxxi + 541 pages.

A catalogue of injurious and beneficial insects, with description of hosts, if any, economic importance of the insect, methods of control, etc.

H. S. FAWCETT

"Brown Rot Gummosis of Citrus." California Cultivator, Vol. XLII, p. 124, Aug., 1914.

"Gray Fungus Gummosis of Lemon Trees." California Cultivator, Vol. XLII, p. 340, Oct., 1914.

"Psorosis or Scaly Bark of Orange Trees." California Cultivator, Vol. XLII, pp. 340–341, Oct., 1914.

"Citrus Canker." Monthly Bulletin, State Comm. of Hort., Dec., 1914.

"The Known Distribution of *Pythiacystis citrophthora* and its Probable Relation to Mal di gomma." Phytopathology 5, 66–67, Feb., 1915.

"Citrus Diseases." Eighth Ann. Rept. of Proc. Cub. Nat'l. Hort. Soc., pp. 20–30, Nov. 1914.

An address delivered before the society at Santa Fe, Isle of Pines, Jan., 1914.

H. B. FROST

"A Short-cut in the Computation of Certain Probable Errors." The Amer. Naturalist, Vol. 48, Nov., 1914.

A note on a new mode of quick calculation for statistical purposes.

T. H. GOODSPEED

"Qualitative Studies of Inheritance in Nicotiana Hybrids III." Univ. of Cal. Publ. Botany, Vol. 5, No. 6, pp. 223–231.

'Parthenogensis, Parthenocarpy and Phenospermy in Nicotiana." *Ibid.*, Vol. 5, No. 7.

"Notes on the Germination of Tobacco Seed, II." *Ibid.*, Vol. 5, No. 8.

"Parthenocarpy and Parthenogensis in Nicotiana." Proc. Nat. Acad. Science, Vol. 1.

T. H. GOODSPEED, with R. E. CLAUSEN

"Factors which Influence Flower-Size in Nicotiana." *Ibid.*, Vol. 1.

"Factors which Influence Flower-Size in Nicotiana, with Special Reference to Questions of Inheritance." Amer. Jour. of Botany, Vol. 2.

G. P. GRAY

"New Fumigating Machines." Monthly Bulletin Cal. State Comm. Hort., Vol. 4, No. 2, p. 1, Feb., 1915.

"The Workings of the California Insecticide Law." Jour. Ind. and Eng. Chem., Vol. 6, No. 7, p. 590.

"The Compatibility of Insecticides and Fungicides." Monthly Bulletin Cal. State Comm. Hort., Vol. 3, No. 7, p. 265.

"Bug-Bat Insecticides." Univ. Cal. Jour. Agr., Vol. 2, No. 4, p. 146.

G. W. HENDRY

"Bean Culture in California." California Cultivator, Vol. XVIV, p. 555, May, 1915.

W. B. HERMS

"Health on the Farm." Univ. of Cal. Jour. of Agr., Vol. II, No. 4, pp. 136-137.

A brief account calling attention to the value of health as an economic asset to the farmer, and disease as an enemy over which man has been given power. A brief statement is made of the various ways to control disease and maintain a condition of health which ought to be the normal state.

"Anti-Mosquito Work in California." Sacramento (Cal.) Union, Vol. 180, No. 10, p. 13, Jan. 10, 1915.

A statement of the various mosquito crusades conducted in the state under the direction of the writer; an account of the methods applied, cost of work and an appeal for a state-wide organization against mosquitos.

"Control and Prevention of Typhoid Fever on the Farm." Univ. of Cal. Jour. of Agr., Vol. II, No. 5, pp. 184–186.

Calling attention to the fact that there is more than half again as much typhoid fever in the rural parts of California than in the cities, and citing the State Board of Health instructions to prevent the spread of the disease, also suggestion with regard to water supply, milk supply, disposal of excreta, flies, typhoid carriers and typhoid vaccination.

"Malaria on the Farm, Cause and Control." Univ. of Cal. Jour. of Agr., Vol. II, No. 6, pp. 213–215.

Pointing out the fact that malaria is typically a rural disease. A brief account of malaria and causative parasite is given, and methods suggested for the control of the responsible mosquito-carrier.

"Successful Methods of Attack on Malaria in California." Cal. State Jour. of Medicine, Vol. XIII, No. 5, pp. 185–189.

A description of the methods used by the writer in organizing antimalaria campaigns. Statistics are given indicating the results secured in various counties.

D. R. HOAGLAND

"Organic Constituents of Pacific Coast Kelps." Jour. of Agr. Research, Vol. IV, No. 1, April, 1915, p. 39.

Detailing studies on certain important organic constituents of Pacific Coast kelps, qualitatively and quantitatively. Discussion of economic importance of same.

W. T. HORNE

"Diseases of the Olive." California Cultivator, Vol. 43, No. 17, p. 388.

A popular statement with reference to various pathological conditions found on olive trees and hints as to causes and measures for control.

"Oak Fungus Disease." California Farmer Section of Oroville Mercury, Aug. 6, 1914.

Popular statement with respect to nature of oak root fungus disease, its occurrence, prevention, treatment, and general control measures. With illustrations.

"Some Neglected Features of Wood Decay in Orchard Trees." Univ. of Cal. Jour. of Agr., Vol. 2, No. 2, Oct., 1914.

Popular statement of causes, manifestations and methods of control of wood decay.

"Oak Fungus or Armillaria mellea in Connection with Nursery Stock." Monthly Bulletin Cal. State Comm. Hort., Vol. 4, No. 4, p. 179.

A statement for benefit of fruit growers on occurrence of oak root fungus in nursery stock, its dangers to orchard production, duties of horticultural commissioners in connection therewith, etc.

W. G. HUMMEL

"Utilization of Land by High Schools Teaching Agriculture." Part I, "The School Farm," Univ. of Cal. Chronicle, Vol. XVI, No. 4, p. 3.

Part II soon to appear.

M. E. JAFFA

Report of Chemist of State Board of Health in Report State Board of Health, 1912–14, pp. 247–289.

Containing the results of analytical work done in the State Food and Drug Laboratory. The data includes the examination of 2687 samples miscellaneous foods and food supplies.

The co-operative work of the State Laboratory in the matter of the examination of supplies furnished state institutions has formed an important part of the work during the past two years. The supplies referred to consist not only of all forms of food, food products, and drugs but miscellaneous articles, such as blankets, coal, cutlery, oils, soaps, etc. Excellent results have followed such co-operation, in that the supplies furnished state institutions have greatly improved in quality, so that there is practically no waste with reference to the matter of food and drugs, and the financial saving has been very appreciable. The following general summary may be of interest:

	Adulterated, per cent	Misbranded, per cent	Adulterated and misbranded, per cent	Complying with the law, per cent	Total
To August, 1908	20.9	9.0	13.0	57.1	100
To August, 1909	9.7	22.8	9.9	57.6	100
To August, 1910	5.9	21.1	14.6	58.2	100
To August, 1911	14.3	36.1	2.4	47.2	100
To August, 1912	4.8	15.6	12.2	67.4	100
To July, 1914	5.0	8.7	14.0	72.3	100

Reports in the monthly bulletins of the State Board of Health of the work of food and drug examinations, 1 to 2 pages per month.

KATHERINE D. JONES

"Acacia," an account of those grown mostly in Western North America. Published in Bailey's Standard Cyclopedia of Horticulture, Vol. I, March 25, 1914.

This includes botanical descriptions and cultural notes on the acacias introduced from Australia and grown for ornamental purposes, mostly in California.

W. P. KELLEY

The Lime-Magnesia Ratio, I: The Effects of Calcium and Magnesium Carbonates on Ammonification. Cent. fur Bakt., etc., 2 te Abt., Vol. 42, p. 519.

The Lime Magnesia Ratio, II: The Effects of Calcium and Magnesium Carbonates on Nitrification. Cent. fur. Bakt., etc., 2 te Abt.

Ammonification and Nitrification on Hawaiian Soils. Bull. 37, Hawaii Agr. Exp. Station.

These three papers are a contribution to the microbiology of Hawaiian soils and important points treated are the relation of lime and magnesia to bacterial activity in ammonification and nitrification processes, the validity of the lime magnesia ratio hypothesis with respect to them, the effect of burning, aeration and other factors on the bacterial activities referred to.

CHARLES B. LIPMAN

''The Poor Nitrifying Power of Soils, a Possible Cause of 'Die-Back' (Exanthema) in Lemons.'' Science, n. s., Vol. 39, No. 1011, p. 728.

Points out the accompaniment of poor nitrifying powers of soils with die-back conditions in citrus trees. Also briefly describes experiments which indicate a possible causal relationship between the condition noted and die-back.

''Antagonism between Anions as Related to Nitrogen Transformation in Soils.'' The Plant World, Vol. 17, No. 10, p. 295.

Explains the effectiveness of the neutralizing power of one salt over the poisonous properties of another salt with reference to bacterial processes by which organic nitrogen in soils is changed successively to ammonia, nitrites and nitrates. Very large amounts of alkali may be resisted if salts are properly mixed.

''A Suggestion of a New Phase of the Problem of Physiological Diseases of Plants.'' Phytopathology, Vol. 5, No. 2, p. 111.

Discussion of abnormal nitrification conditions occurring in soils on which die-back, mottled leaf, and little leaf occur, and pointing out the possibility of a relationship between the two. A plea for more soil studies in connection with physiological diseases of plants.

''The Nitrifying Powers of Soils as Indices to Their Fertility.'' Proc. Soc. Prom. Agr. Science, No. 1914.

In explanation of conditions in grain fields in which small or large fertile spots are found in a field in which grain is otherwise poor and attempt to point out a general principle based thereon.

''Some Common Misconceptions with Respect to Soils and Soil Fertility.'' California Home and Farmer, Feb. 20, 1915.

Discussing critically the present status of knowledge on soil fertility for practical purposes before California Fruit Growers' Convention, November, 1914.

''Report to the Associate Referee on Soils.'' A. O. A. C., Nov., 1914. American Fertilizer, Vol. 41, p. 32.

CHARLES B. LIPMAN and PAUL S. BURGESS

''Antagonism between Anions as Affecting Soil Bacteria, III: Nitrogen Fixation.'' Cent. Fur. Bakt., 2 te Abt., Vol. 42, No. 17–18, p. 502.

Showing how one salt prevents toxic effects of other salts for bacteria.

"The Protective Action against $MgCO_3$ of C_aCO_3 for A. Chroococcum." Jour. Agr. Science, Vol. 6, Part IV, p. 484.

Demonstrating toxicity of $MgCO_3$ to pure cultures of nitrogen fixing bacteria of the non-symbiotic type in both solutions and soils and how it may be prevented to a considerable degree by C_aCO_3.

"Studies on N. Fixation and Azotobacter Forms in Soils of Foreign Countries." Cent. fur Bakt., 2 te Abt. (Soon to appear.)

A study extending over two years of factors mentioned in title in about sixty soils representing nearly all continents and important soil areas. New Azotobacter species described and many new facts brought to light.

Charles B. Lipman and L. W. Fowler

"Isolation of B. radicola from Soil." Science, n. s., Vol. 41, No. 1050, p. 256.

Gives an account of direct isolation of B. radicola from soil which had been bare for several months but which had grown a variety of vetch. See also letter soon to appear in another number of Science.

Charles B. Lipman and W. F. Gericke

"Antagonism between Ions as Affecting Barley Yields on a Clay Adobe Soil." Jour. Agricultural Research, May, 1915.

Showing the protective action of chlorides against sulfates and carbonates of sodium amongst themselves against too toxic action of any one to barley grown in pots on adobe soil. Shows that doubling and even tripling a very toxic salt content may yet permit good growth if combination of salts is proper, even though they be all sodium salts.

Charles B. Lipman and L. T. Sharp

"Effect of Moisture Content of a Sandy Soil on its Nitrogen Fixing Power." Bot. Gaz.

Demonstrating optimum, minimum and maximum water percentages which allow of nitrogen fixation by the natural soil flora of a sandy soil.

"A Preliminary Report of New Experiments on Alkali Soil Treatment." Univ. Cal. Publ. Agr. Sci., Vol. I, No. 9, p. 275.

Discussion of striking results obtained in improvement of alkali soils in pot work in greenhouse by chemical treatment and calling attention to similar field experiments in progress.

R. H. Loughridge

"Humus and Humus Nitrogen in California Soil Columns." Univ. Cal. Publ. Agr. Sci., Vol. I, No. 8, p. 173.

Gives an account of humus studies made by author and associates on more than one hundred soil columns to depths of 12 feet. The most striking result among many described is the demonstration of the occurrence of humus to great depths in arid soils commonly to 12 feet from the surface. This is in striking contrast with eastern soils.

J. W. Nelson

"Reconnaissance Soil Survey of the Sacramento Valley." U. S. Department of Agriculture, Field Operations of Bureau of Soils for 1913, with L. C. Holmes, joint report. Issued April 26, 1915, p. 148.

"Fruit Soils of the Sierra Foothills." Monthly Bulletin State Department of Horticulture, Vol. 4, No. 3, pp. 134–139.

"Fruit Soils of the Great Interior Valley." Monthly Bulletin State Department of Horticulture, Vol. 3, No. 9, pp. 343–351.

W. E. **Packard**

"Cotton Growing in California." Mo. Bull. State Comm. Hort. Cal. Vol. IV, No. 4, p. 185.

A survey of the situation with respect to cotton production in California. Gives statistics with regard to acreage planted, tonnage produced, quality of fiber, nature of soils available, most promising varieties, and other information for the student of the industry.

H. J. **Quayle**

"Citrus Fruit Insects in Mediterranean Countries." Bull. 134, Professional Paper, Bureau of Entomology, U. S. Department of Agriculture.

This bulletin gives an account of the author's studies on citrus fruit insects in the countries bordering the Mediterranean. The chief object of these studies was to determine to what extent the Mediterranean fruit fly occurred in the lemons in that region, also the different scale insects and mealy bugs attacking citrus trees, and the olive fly. An account is also given of the Mediterranean citrus fruit industry.

"The Citricola Scale." Jour. of Economic Entomology.

A short summary account of this scale from the economic viewpoint.

C. F. **Shaw**

"Reconnaissance Soil Survey of Southeastern Pennsylvania." U. S. Department of Agriculture, Bureau of Soils, Field Operations for 1912, 100 pages. (Issued Nov. 6, 1914.)

"Soils of Pennsylvania." Pennsylvania State College of Agriculture and Experiment Station Bull. No. 132, pp. 209–242. (Issued Jan., 1915.)

C. O. **Smith**

"Walnut Blight or Bacteriosis." Amer. Nut Journal, Aug., 1914. (Continued in the March, 1915, issue.)

"Crown Gall, Black Knot, Plant Tumor or Plant Cancer." Better Fruits, Jan., 1915.

R. E. **Smith**

"The Investigations of 'Physiological' Plant Diseases." Phytopathology, Vol. 5, No. 2 (1915), p. 83.

A review and conspectus of present-day status of subject of "physiological" plant diseases, from author's standpoint. New problems and new methods of attack are pointed out and critically discussed.

R. E. **Smith** and A. **Boncquet**

"New Light on Curly Top of the Sugar Beet." Phytopathology, Vol. 5, No. 2, p. 103.

Authors discuss experiments made by them in which definite proof is given of corroboration by them of relation of Eutettix tenella to Curly Top. Other findings and experiments in connection therewith are also briefly discussed with reference to symptoms, etiology, etc., of disease.

G. R. **Stewart**

"Availability of the Nitrogen in Pacific Coast Kelps." Jour. of Agricultural Research, Vol. IV, No. 1, April, 1915, p. 21.

A study of availability of nitrogen in Pacific Coast Kelps with ammonifiability used as criteria. Differences in availability found between nitrogen forms in different kelps. In general, nitrogen in kelps showed very low availability.

E. P. VAN DUZEE

"Nomenclatural and Critical Notes on Hemiptera." The Canadian Entomologist, Nov., 1914, p. 377.

Mr. Crawford's Recent Work on the Delphacinae. Psyche., p. 163.

"A Preliminary List of the Hemiptera of San Diego County, California." Transactions of the San Diego Society of Natural History, Vol. 2, No. 1, Nov., 1914.

E. C. VAN DYKE

"The Species of Cossonus Clairy. (Coleoptera) of America North of Mexico." Bull. of the Brooklyn Ent. Soc., Vol. 10, No. 1, p. 1, Feb., 1915.

E. J. WICKSON

"California Garden-Flowers, Shrubs, Trees and Vines." A manual for amateurs working under California conditions of soil and climate. Published by Pacific Rural Press, San Francisco. 262 pages; 12 halftone plates, and many text illustrations.

"California's Magazine: Cornerstone Number," June, 1915. Contributions by 136 California writers concerning the resources, industries and future development of the state. Published by Publishers Co-operative Association, San Francisco. Large octavo 672 pages, profusely illustrated with color plates and halftones.

"Development of Agriculture on the Pacific Coast": article in "Nature and Science on the Pacific Coast." Published by Paul Elder & Co, San Francisco.

"California Fruit Industries," article in Vol. 5, "History of California," by Z. S. Eldredge. Published by Century History Co., New York.

F. W. WOLL

"Productive Feeding of Farm Animals." Published by J. B. Lippincott Company, Philadelphia; 362 pages, 96 illustrations.

C. W. WOODWORTH

"The Rate of Hatch of Scale Insect Eggs." The Canadian Entomologist, Dec., 1914.

A note with statistical statement on the subject.

"Classification of Orders and Insects." Entomologist News, Vol. 26, p. 120.

A note on systematic work in entomology.

"The Toxicity of Insecticides." Science, n. s., Vol. 41, No. 1053, p. 367, March 5, 1915.

H. D. YOUNG

"Composition of Frozen Oranges and Lemons." Jour. Ind. Eng. Chem. (Soon to appear.)

Finds that the specific gravity of frozen oranges decreases considerably following freezing due to the loss of water from the pulp, whereas normally oranges lose water upon standing from the rind only. The freezing evidently kills the cells, destroying their semi-permeability and thus permitting water to pass out rather freely. The composition of the orange is also affected by freezing, the sugars and acid both becoming reduced upon standing.

INSTRUCTIONAL AND ROUTINE WORK

RESIDENT INSTRUCTION

Seventy-three Bachelor's degrees and six Master's degrees were given to students of the College of Agriculture, while thirty-six certificates were given to students completing the three-year course in agriculture at the University Farm School. The University students in agriculture have increased in two years from 490 to 619, while the Farm School students have increased from 157 to 289. In the first instance the increase was 129 and in the second instance 132. It is also interesting to note that 169 freshmen in agriculture entered at Berkeley, while 170 first-year students, with an average age of 20 years and one month, entered the Farm School at Davis. In other words, 339 students of college age entered the University of California last fall to study agriculture. The students of the Farmers' Short Courses numbered 186 and averaged about 25 years of age. If this number be included, then 525 new students entered the University this year to study agriculture.

There has been no material increase in individuals taking the Farmers' Short Courses during the two years, although on account of lengthening these courses a considerable increase in work has occurred. Nevertheless the attendance upon them has not been equal to the opportunities offered. The instruction has been carefully planned, is given by leading men of the department, and deserves to be attended by larger numbers of the farmers of California.

AGRICULTURAL CORRESPONDENCE COURSE INSTRUCTION

Perhaps the activity which has had the widest influence and touched the people in the closest and most effective manner has been the Correspondence Courses in Agriculture, by the Division of Agricultural Education.

A total of 9198 students have registered for correspondence courses in agriculture from May 1, 1914, to April 30, 1915. Prior to April 30, 1914, 6424 students had registered. This makes the total number of different students to date 15,622. However, 2725 re-enrollments bring the total number of enrollments, in courses now ready, up to 18,347. In addition, 1110 have made application for courses not now ready. Of the total number of students, 2832 have completed one or more courses, the total number of 3880 courses being completed.

Thirty-three per cent of the students enrolled this year are actually engaged in farming. Twelve per cent are housewives, a majority of whom are farmers' wives. Two per cent are engineers. Twelve per cent are tradesmen and mechanics. Two per cent are merchants. Three per cent are teachers. Fifteen per cent are clerks, stenographers and bookkeepers. Two per cent are brokers, real estate and insurance men. Four per cent are students, while the occupation of 12 per cent is unknown. The average age of students is estimated to be 33, ranging from 10 to 85 years.

Correspondence students have been enrolled from every county in California. They have also enrolled from forty-two other states, the District of Columbia, Alaska, Hawaii, Philippines, Porto Rico, Canada, Fiji Islands, Greece, India, Mexico, Africa, England and various small islands of the West Indies.

During the year 169,936 pieces of mail matter were sent out in the conduct of the Agricultural Correspondence Courses, exclusive of announcement circulars.

AGRICULTURE IN CALIFORNIA SCHOOLS

Hummel reports that agriculture is now taught in 64 high schools. Of these, 21 give a one-year course, 24 give a two-year course, 8 give a three-year course, and 11 give a four-year course.

Thirty-one teachers of agriculture in California high schools are graduates of agricultural colleges. Nine others have had some agricultural education. Fifty-six have had farm experience, ranging from one to over twenty-five years. Many were born and raised on farms. The salaries of agricultural teachers range from $1000 to $2160.

Fifty-four high schools teaching agriculture own or rent land in connection with their agricultural instruction. The amount varies from one-fourth of an acre to twenty-nine acres. Students do all the work on twenty-four of these school agricultural plots. Other schools teaching agriculture hire some work done on the agricultural ground, but frequently this is only plowing. A greenhouse, lathhouse, or both, is used by twenty-six schools in connection with agricultural instruction.

COUNTY FARM ADVISERS

Farm Advisers have been established in eleven counties in cooperation with the United States Department of Agriculture. These counties in order of the appointment of the Farm Adviser are: Humboldt, San Joaquin, San Diego, Yolo, Alameda, Kern, Madera, Napa, Ventura, Glenn, and Solano. No farm adviser is installed until (*a*) a farm bureau is organized with at least one-fifth the farmers in the county in its membership and (*b*) the Board of Supervisors appropriate $2000 per year for the expenses of the farm adviser. No funds for this work are accepted from any other source than from the county, state, and national governments. The farm adviser's work is organized through the county farm bureau. He travels about the county on schedule, completing the circuit of the farm bureau centers once a month, and visiting those farms to which he is called.

BOYS AGRICULTURAL CLUBS

Agricultural clubs are established in sixty-five high schools of the state. The object of these clubs is to stimulate a greater interest in agriculture among high-school boys and to spread a knowledge of better agricultural methods. The club members participate in a crop-growing contest each year, the winner being the boy who makes the largest profit, which is not necessarily the same as making the largest yield. Plots in the various clubs vary from one-tenth of an acre for onions to one acre for corn. The net profit ranged as high as the rate of $780 per acre in last year's contest. Thirty-seven clubs finished with six or more boys completing the contest, and of these twenty clubs locally raised the funds and sent their prize-winner, under the guidance of the University on a transcontinental tour of 9000 miles, visiting 24 states, Canada and Mexico, stopping at 24 cities and seeing twelve of the most prominent types of farming in America. At the same time 147 other boys who had done good work in the clubs were sent by their home communities on a three-day trip to the University Farm and to Berkeley.

FIELD DEMONSTRATIONS

The older methods of Farmers' Institutes are gradually giving way to more effective methods of instruction. It consists in confining the work to a single limited topic of timely interest. The plan has been to advertise a meeting through some local body, to demonstrate some particular operation which should be performed immediately, or within a few days or weeks. A short lecture is given in a hall and the rest of the time spent in the field actually performing the work. The method economizes the time of both demonstrators and auditors. No one attends except those personally interested in the work, and one demonstrator, sometimes with an assistant, is all that is needed. Demonstrations of this kind have been given on pruning vines and olives of various ages, sulfuring, control of cutworms, vine hoppers, improved methods of wine making, etc. The attendance at the meetings has often exceeded that at the usual Farmers' Institutes and the cost is less.

Farmers' Institutes of the ordinary type are still conducted in counties not having the Farm Adviser system. In the latter counties all extension work is conducted through the Farm Adviser in connection with the farm bureau centers.

WATER ANALYSES

The rural public has, during this year, shown increased demand for and reliance on examinations made by the Agricultural Chemistry Laboratory to determine the suitability of water for domestic use, watering stock and irrigation. For these purposes there have been made about 60 complete and 300 partial water analyses. Experience indicates that in most cases a partial analysis is adequate for the purpose of showing the suitability of a water for any ordinary use. The time and expense required to make a complete water analysis seems to be justified in a few cases which cannot with certainty be decided by a partial analysis.

Numerous request for analyses to determine supposed medicinal value of or rare substances in water have been refused, on the ground that such analyses are not of general public interest, and that they are frequently desired to aid in commercial exploitation of such water. Persons making such request are advised to seek the services of commercial chemists.

As the layman is not ordinarily able to understand a technical report of water analysis, such reports are not usually given to the inquirer. Instead is given a simple statement as to the suitability of the water for the purpose intended, the necessity for avoiding pollution by sewage, etc., and the damages to be feared from continued use of saline water for irrigation.

HOG CHOLERA

The California Agricultural Experiment Station continues to manufacture and distribute serum and virus for the prevention of hog cholera. It is estimated that by their use a loss of 50,000 hogs has been directly prevented during the year. The campaign for disinfection, quarantine and better methods of handling which naturally followed has doubtless resulted in further reducing the ravages of this disease. It is the policy of the station not to advise the use of virus unless the disease already exists on the farm or in the neighborhood.

Unfortunately many hog raisers are loath to accept the fact that it is cholera which affects their hogs when the disease breaks out.

By the time they are convinced most of the hogs have become diseased. Two things every hog raiser should understand: first, that in at least nine cases out of ten when a hog dies of disease that disease is cholera; second, no well-developed case of cholera can be cured by inoculation. It is necessary to inoculate before the disease is well developed. Consequently when cholera breaks out in a herd immediate action is necessary if the well hogs are to be saved.

The method of using both serum and virus, which seems to be the desirable means of controlling an outbreak of cholera under California conditions, has been found to be fraught with certain danger when in the hands of the uninformed. It is possible to kill hogs which might have otherwise recovered, and there is a possibility of spreading the disease, although there appears to be no evidence that this has actually occurred. Fortunately an intelligent hog raiser may with proper instruction become a reliable user of this somewhat delicate method. The Division of Veterinary Science is prepared to offer this instruction free of charge to hog owners who can spend a week at Berkeley or at the Short Course, Davis.

THE ANTI-HOG CHOLERA SERUM

The Anti-Hog Cholera Serum Laboratory has continued to distribute serum at cost. The following table shows the results of the distribution of serum for the year ending March 13, 1915:

Total number applications received	911
Total number hog owners making application	531
Total number c.c. serum used	1,687,500
Total number c.c. virus used	18,662.5
[21]Total number hogs mentioned in applications to be treated	36,909
Total number hogs visibly sick	1,229
Total number using serum and laboratory virus	373
Total number using serum and local virus	138
Total number using serum alone	400
Percentage of well hogs that lived	93
Percentage of sick hogs that lived	38

A veterinarian or a man from the laboratory has been sent to treat the hogs on 109 different occasions.

LIVE STOCK EXHIBIT

The Animal Husbandry Division made its usual exhibition of live stock at the State Fair this year. Only animals raised at the University Farm were shown for prizes. The seventy-eight head shown were awarded sixteen championships, thirty-one first, ten second, five third, and three fourth prizes. This exhibit was later displayed at the county fairs at Pleasanton, Fresno, Hanford, and Riverside. At these county fairs the exhibit was in the hands of Farm School students, whose ability to handle it was acquired at the University Farm School.

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[21] This is approximately 57 per cent of the total number of hogs vaccinated.

ADVANCED REGISTRY COWS

All the cows in the University herd tested for Advanced Registry qualified with creditable year's records. The seven Holsteins tested averaged 13,186.5 pounds of milk and 474 pounds of butter fat; four Jerseys, 8333 pounds of milk and 443 pounds of butter fat; two Guernseys, 9591.5 pounds of milk and 423 pounds of butter fat; one Ayrshire, 10,465 pounds of milk and 445 pounds of butter fat. One Holstein, two Jerseys and one Guernsey were heifers with first calf.

OFFICIAL TESTS OF DAIRY COWS

The total number of cows tested for official records during the year was 567, against 428 during the preceding year, an increase of over 32 per cent. Of this number, 289 cows were tested once a month for one-year records, while 287 cows, nearly all Holstein-Friesian, were tested for seven-day records and a few for 14- or 30-day records. The number of breeders for whom tests were conducted and the total number of cows tested for each breed were as follows: One Ayrshire breeder with 2 cows; 5 Guernsey breeders with 61 cows; 25 Holstein breeders with 374 cows; 13 Jersey breeders with 130 cows. Sixteen of the seven-day records came over 21 pounds. Two of the latter are larger than any seven-day record previously made in California, viz.: Tula De Kol Pietertje Netherland 106233 (567.7 pounds of milk, 27.057 pounds butter fat, average per cent 4.75) and Fidessa Bloom 110841 (571.5 pounds of milk, 26.831 pounds butter fat, average per cent 4.69). Both these cows were owned by Miss M. M. Holdridge, Modesto. A third seven-day record may also be mentioned, viz., that of Tilly Alcartra 123459, owned by A. W. Morris & Sons Corp., Woodland (632.6 pounds of milk, 24.174 pounds butter fat, average fat content 3.82 per cent). This cow also has another record which was the most noteworthy of any made during the year, viz., the largest authenticated milk production for a year by a cow of any breed, 30,451 pounds of milk, containing 951.87 pounds butter fat. A new state record for the Jersey breed has been established by the cow, Pearl of Venadera, owned by Guy H. Miller, Modesto (11,723.9 pounds of milk and 702.69 pounds butter fat), corresponding to 820 pounds of commercial butter.

EXAMINATION OF CERTIFIED MILK

During the past year the Division of Nutrition has examined in connection with the inspection and control of certified milk by the San Francisco County and Alameda County Medical Milk Commissions.

216 samples of certified milk.
24 samples of certified skimmed milk.
24 samples of certified cream.

The results indicate that with very few exceptions the milk supplied to the consumer is in strict accordance with the rules laid down by the Milk Commissions.

The exceptions referred to, sixteen in number, are distributed among all the dairies one or more times and show fat contents from .1 to 1 per cent lower than is called for by the legal standard.

CERTIFIED DAIRY SUPERVISION

The six certified dairies supplying milk to the counties bordering on San Francisco Bay are supervised by Roadhouse of the Veterinary Division, co-operating with the Alameda County and San Francisco County Medical Milk Commissions. The results of the supervision follow:

Number of veterinary inspections of certified dairies	72
Number of sanitary inspections of certified dairies	60
Number of inspections of milk depots and wagons	1,416
Number of bacteria examinations of milk	272
Number of bacteria examinations of water	18
Average bacteria content of all certified milk	4,974
Number of samples of milk below standard for bacteria	14 or 5.1%
Number of tuberculin tests made of animals in certified dairies	2,246
Number of animals reacting	85
Percentage of animals reacting in all dairies	3.7
Total number of animals tested for purchase	576
Total number of reacting animals for purchase	74
Percentage of reacting animals tested for purchase	12.8

Sixty-three of the eighty-five reacting animals removed from the various dairies during the year, or 74 per cent, were from the animals purchased within the last three years, which demonstrates the difficulty in developing herds of cattle entirely free from disease when the purchase of animals from outside sources is continued. Sixty-four two-year-old heifers which were raised on one of the dairies all passed the test, and this is the rule with all young stock raised from those tested herds.

The subcutaneous and intradermal methods of testing were alternated this year, which probably accounts for the slight increase in the percentage of reactors over last year. The intradermal test is somewhat more searching and may show animals with inactive lesions which might escape the subcutaneous tuberculin test.

The direct microscopic method to estimate bacteria and cell content in milk was used in the examination of 50 samples of certified milk for bacteria and 12 samples for cells; also 12 samples of skim milk and 12 samples of whole market milk and 28 samples of clarified milk were examined for bacteria by this method.

THE VETERINARY CLINIC

The veterinary clinic conducted by Hayes for the purpose of furnishing clinical and pathological material for the instruction of students has increased considerably over the preceding year. In all, 2020 cases have been examined, operated upon, or prescribed for, including 188 horses, 442 cattle, 1343 hogs, 22 sheep and goats, 24 dogs, and 1 cat. Most of this clinical material was brought in by neighboring farmers. Fortunately the losses from disease in the livestock belonging to the University Farm have been light.

RESUME OF WORK OF THE STATE FOOD AND DRUG LABORATORY

The State Board of Health selected the University of California as the location for the State Food and Drug Laboratory for the examination of foods and drugs in connection with the enforcement of the California Pure Foods and Drugs Act. As the Professor of Nutrition directs this work, it may well be considered as one of the activities of the Nutrition Division and a resume of its work be here presented.

During the past year 2043 samples were examined and reported upon by the laboratory. Of this number, 1394 were foods, 474 drugs, and 175 miscellaneous materials. Nearly 200 samples, or between 9 and 10 per cent, were found to be below the required standard of the California law, the violations including both adulterations and misbranding, the percentage of adulterations as such being very low.

One of the most important phases of the work is the co-operation with the State Board of Control, in insuring the delivery of standard foods and drugs to the State institutions, the standard in this case being construed to mean that the delivery would be identical in quality with the sample submitted with the bid upon which the award was made. The stewards of the various State institutions submit samples from their supplies, and when the laboratory finds the delivery sample to be below the standard of the bid sample such delivery is rejected. This co-operative work has resulted in a very noticeable improvement in the quality of the supplies furnished to the State, as well as a large decrease in expenditure.[22]

OTHER ROUTINE ANALYTICAL AND INSPECTION WORK

Under provision of the respective state statutes governing them, fertilizer and insecticide analyses and inspection work have proceeded during 1914–15 with increased activity, owing to the reliance on the part of the public on the work of these two laboratories. Likewise, routine examinations of waters, seeds, and soils to guide the public in their purchase and use have largely increased in number. The volume of such work is shown in the following table, which compares the work of the laboratories concerned for the years 1913–14 and 1914–15. The table also indicates the extent of the correspondence involved in such work.

	FERTILIZERS		INSECTICIDES		WATER		SEEDS		SOILS	
	1913-	1914-	1913-	1914-	1913-	1914-	1913-	1914-	1913-	1914-
Number of samples analyzed or examined	600	595	150	160	225	360	1555	1453	2783	3930
Number of letters written	1800	1800	210	425	225	360	....	....	2515	2700

The two laboratories concerned with the inspection of fertilizer and insecticide products are instrumental not only in keeping the commercial fertilizers and insecticides up to standard, thus safeguarding both the producer and the consumer, but also serve as a means of promoting a proper basis of understanding between vendor and purchaser in cases of doubt.

Work not concerned with the production of wealth from the water and land resources of the state, as for example, the exploitation and prospecting variety, is not prosecuted in station laboratories and must be done by commercial chemists. People desiring the assistance of station laboratories are advised to communicate with the Director of the Agricultural Experiment Station in advance, so that they may obtain station circulars dealing with detailed statements of *work which can and which cannot be done* by our laboratories, and giving directions for the collection and transmittal of samples.

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[22] Full details regarding the work of this laboratory will be found in the biennial reports of the California State Board of Health.

The Seed Inspection Laboratory is maintained under the joint auspices of the Bureau of Plant Industry, U. S. D. A., and the Agricultural Experiment Station. Those who desire a full return from seed planted, and who wish to avoid the wholesale introduction of noxious weeds into their land, profit by availing themselves of the services of this laboratory.

THE UNIVERSITY FARM

At the University Farm there have been several distinct additions to the material equipment, notably a classroom building costing $65,000 and containing in addition to offices and classrooms the library and an auditorium with a seating capacity of 550 persons. The Dining Hall addition and Dormitory No. 3 have been finished and occupied. The Beef Barn has been completed. An inexpensive shed with five corrals for sheep-feeding experiments has been constructed. A tool shed 28 by 100 feet is in process of construction by the students in building construction. An equipment of desks with drawers and lockers for laboratory work in soils has been installed on the second floor of the Horticulture Building.

THE UNIVERSITY FARM SCHOOL GRADUATES

The following students were given a certificate on May 21, 1915, upon successfully completing the three years' course in agriculture at the University Farm School:

James Peter Anderson
John Edwin Arnold
Hugh George Asselstine
John Frederick Aubin
Ralph Olaf Bayley
Raymond Nason Becket
Howard Clyde Brown
Edward John Cahill
John Edward Chesson
James Bacon Cutten
William Langan Fottrell
Herman Edwin Freyschlag
Lester Bowen Gale
Launcelot John Gamble
Jose Guevera
Earl Marshutz Hammer
Irving Newton Harshbarger
Ferdinand Wills Hoffman
Saurin D. King
Max Adolphus Kortum
Julius William Krafft
Kenneth Clark Laugenour
Andrew Warren McCann
Benson Brooke McGann
Jesse Baldwin McKillip
Carl Gustave Meiners
William Thomas Mosgrove
Arthur Samuel Paul
Arthur Hubert Rivett
Nicholas Ralph Romaine
Roy John Stettler
William Farrington Stone
Earl Eugene Taylor
Charles Frevert Tucker
Jack Ventuleth
Elmer Randall Verrue

THE CITRUS EXPERIMENT STATION AND GRADUATE SCHOOL OF TROPICAL AGRICULTURE

During the year this branch of the work of the Department of Agriculture has been perfected under the management of Director H. J. Webber. While this station is organized primarily for research and graduate instruction, members of the staff are burdened with a considerable amount of extension work. It is estimated that 1600 people visited the Riverside Station during the year seeking information. Members of this staff gave eighty-four lectures, with an estimated attendance of 12,000.

At a special meeting of the Regents of the University, held December 23, 1914, a new site for this station, containing 465.29 acres of valley and hill land, was selected. Of this amount, about 350 acres are tillable, while the remaining is rocky, hilly land, which may be valuable for tests of the practical utilization of such waste land. The irrigation water for the land is provided by a well guaranteed to produce 120 inches. The site is located about two and one-half miles southeast of the center of the city of Riverside, on the Box Springs boulevard.

PERSONNEL

There have been 38 appointments by the Regents to the Department of Agriculture since the announcements made in the last Director's Report. Some of them have been made to fill vacancies occurring during the year. The largest number of appointments has been made in the Division of Agricultural Extension in developing the system of farm advisers under the Smith-Lever Act. Notable among the developments of the year are the creation of the Divisions of Rural Institutions and Agricultural Engineering and the further additions to the divisions of Forestry and Pomology, as well as the additional investigators in the Citrus Experiment Station. The appointments are listed below.

HERMAN J. BAADE, Assistant in Agricultural Extension, Farm Adviser of Napa County.

LLOYD EVAN BAILEY, Assistant in Soil Chemistry.

LEON D. BATCHELOR, Associate Professor of Plant Breeding in the Citrus Experiment Station and Graduate School of Tropical Agriculture.

JERRY RAYMOND BEACH, Assistant in Veterinary Science.

DONALD BRUCE, Assistant Professor of Forestry.

CHARLES BURGE, Assistant in Animal Husbandry.

HARRY MORTON BUTTERFIELD, Assistant in Agricultural Education.

CURTIS PAUL CLAUSEN, Assistant in Entomology at the Citrus Experiment Station.

JAY BROWNLEE DAVIDSON, Professor of Agricultural Engineering.

JAY DWIGGINS, Jr., Instructor in Physical Education at the University Farm School.

CLIFFORD FRANKLIN ELWOOD, Assistant in Agricultural Education.

EDWARD OLIVER ESSIG, Instructor in Entomology.

STANLEY B. FREEBORN, Instructor in Entomology.

ROYAL FREDERICK HAVENS, Assistant in Poultry Husbandry.

W. H. HEILEMAN, Assistant in Agricultural Extension; Farm Adviser in Glenn County.

WALTER LAFAYETTE HOWARD, Associate Professor of Pomology.

WALTER PEARSON KELLEY, Professor of Agricultural Chemistry in the Graduate School of Tropical Agriculture and Citrus Experiment Station.

M. A. KLEIN, Instructor in Soil Chemistry and Bacteriology.

MURL BYRON KURTZ, Assistant in Veterinary Science.

RONALD R. MACK, Assistant in Agricultural Extension; Farm Adviser in Kern County.

FRANCIS MARION MARQUIS, Assistant in Veterinary Science.

DAVID TOWNSEND MASON, Professor of Forestry.

THOMAS CLAY MATTILL, Assistant Professor of Nutrition.

HENRY ALBRIGHT MAYHEW, Assistant in Agricultural Extension; Farm Adviser in Madera County.

ELWOOD MEAD, Professor of Rural Institutions.

WOODBRIDGE METCALF, Assistant Professor of Forestry.

ROBERT F. MILLER, Assistant Professor of Animal Husbandry.

JAMES W. MILLS, Assistant in Agricultural Extension; Farm Adviser in Solano County.

Mrs. AGNES FAY MORGAN, Assistant Professor of Nutrition.

WALTER HALL NIXON, Assistant in Agricultural Extension; Farm Adviser in Alameda County.

WILLIAM B. PARKER, Assistant in Agricultural Extension; Farm Adviser in Ventura County.

ROBERT LARIMORE PENDLETON, Assistant in Soil Survey in the Division of Soil Technology.

HOWARD SPRAGUE REED, Professor of Plant Physiology at the Citrus Experiment Station and Graduate School of Tropical Agriculture.

RICHARD SCHMIDT, Orchardist at the University Farm.

JACOB TRAUM, Assistant Professor of Veterinary Science.

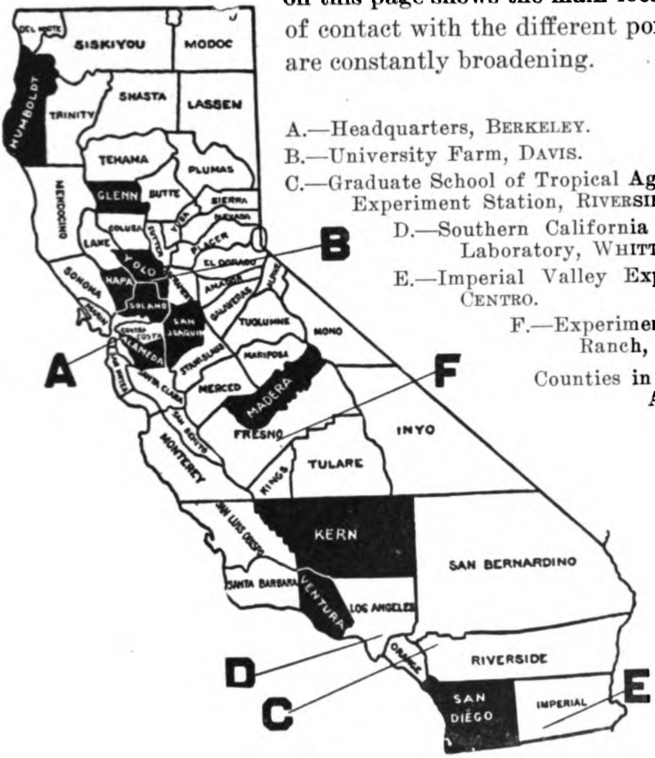
ROLAND S. VAILE, Assistant Professor of Orchard Management.

E. P. VAN DUZEE, Instructor in Entomology.

HENRY A. WEINLAND, Assistant in Agricultural Extension; Farm Adviser in San Diego County.

ORGANIZATION

The activities of both the College of Agriculture and the Experiment Station are widely distributed throughout the state. The map on this page shows the main location. The points of contact with the different portions of the state are constantly broadening.



A.—Headquarters, BERKELEY.
B.—University Farm, DAVIS.
C.—Graduate School of Tropical Agriculture and Citrus Experiment Station, RIVERSIDE.
D.—Southern California Plant Pathological Laboratory, WHITTIER.
E.—Imperial Valley Experiment Farm, EL CENTRO.
F.—Experiment Tracts, Kearney Ranch, FRESNO.

Counties in black have Farm Adviser

The Division of Forestry has three small tracts under its supervision, viz., at Santa Monica, at Chico and at Whitaker's Forest in the Sierras, Tulare County.

Where a region is not served either by a substation or a farm adviser it is reached by the Division of Agricultural Extension through farmers' institutes and movable schools, or by special experiments conducted by different members of the staff to assist in solving local problems.

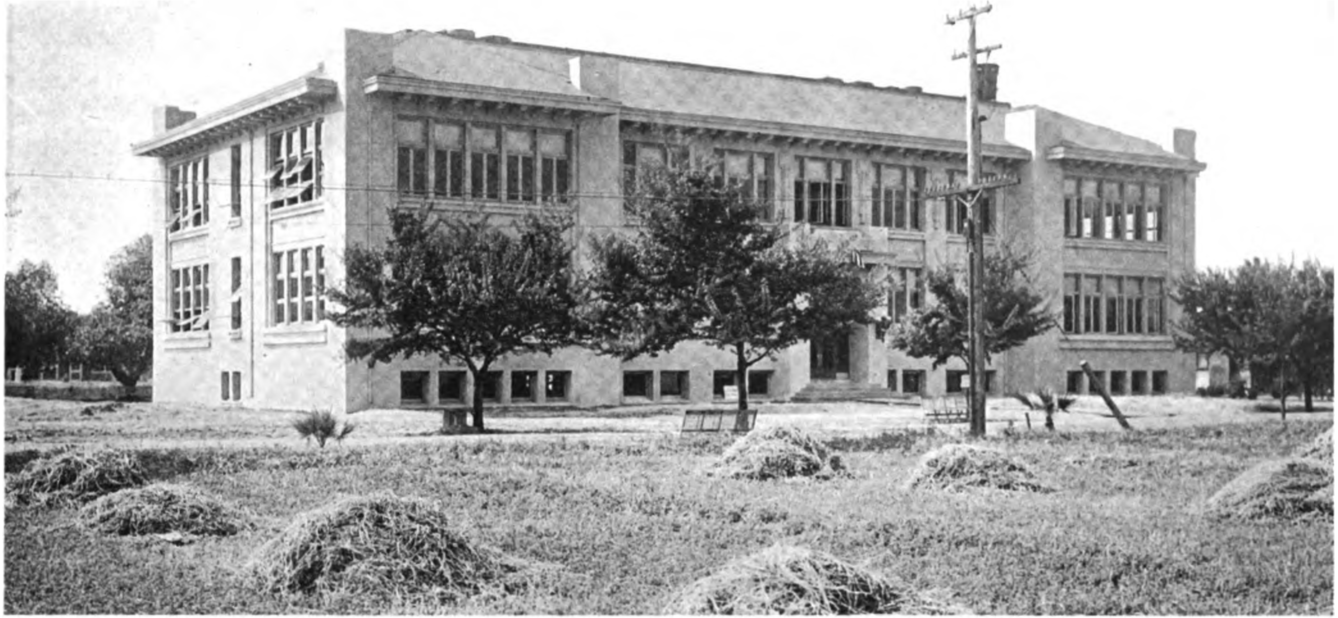
The faculty of the Department of Agriculture is divided into three main groups: (1) Headquarters, on the University Campus; (2) The University Farm at Davis; and (3) The Citrus Experiment Station and Graduate School of Tropical Agriculture, with men located at both Riverside and Whittier. Each group of men attend to local matters which may arise from time to time, while at least twice a year all meet together at Berkeley to consider matters of common interest and responsibility.

The Department of Agriculture has not as yet been able to realize its ideals in solving the many involved problems which beset the agriculture of California; in developing its resident instruction; nor in helping the men and women who are bravely struggling to create wealth out of the soil and at the same time raise a virile and capable family. The members of the staff have a keen sense of their responsibilities, as illustrated by the following quotation from a letter received by the Director from a member of the staff:

> I believe we are now building the foundation for a great work in this state and we are trying to do it well, so future plans can be laid to meet the greatest good. I am looking forward with much interest to the time when our basic work will be sufficiently advanced so we can begin the superstructure of a comprehensive series of experiments.
>
> My interests are centered in the work and its future possibilities and I feel confident . . . that we will be able to formulate a line of investigation which will enter a very important field in plant growth, yet little disturbed.
>
> I assure you that my fullest support lies with the University and every effort will be exerted to promote the greatest good possible from united effort.

In whatever ways, therefore, the department may fail to reach its aims, it is not in any measure due to the lack of conscientious endeavor on the part of members of the department with whom I have the honor to be associated.

Respectfully submitted,
THOMAS F. HUNT.



THE CLASSROOM BUILDING AT THE UNIVERSITY FARM

Cost $65,000 and contains in addition to offices and classrooms, the library and an auditorium with a seating capacity of 550 persons.

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REPORT

OF THE

COLLEGE OF AGRICULTURE

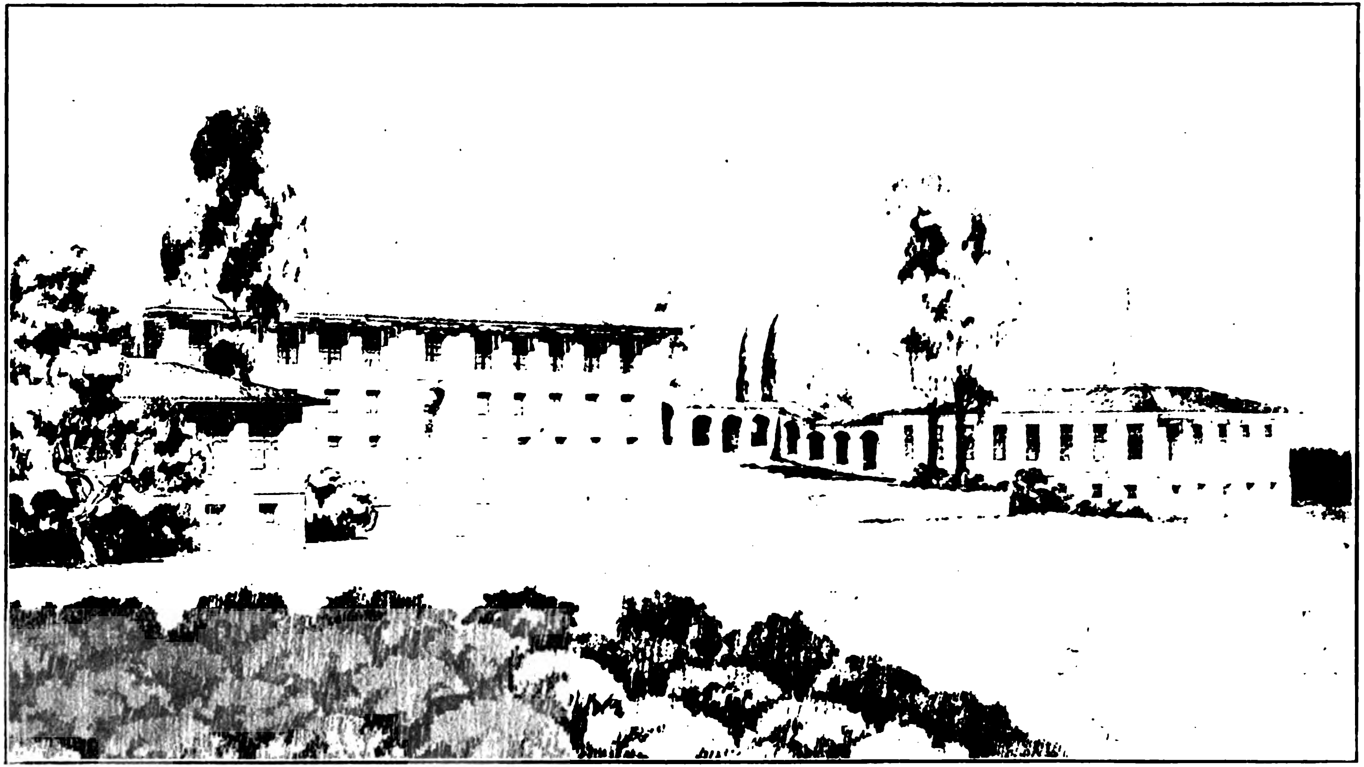
AND THE

AGRICULTURAL EXPERIMENT STATION

OF THE

UNIVERSITY OF CALIFORNIA

FROM JULY 1, 1915, TO JUNE 30, 1916



The Laboratory Buildings of the Citrus Experiment Station, Riverside, California.

"The broad, overhanging, tiled roofs, plastered walls, arched doorways and massive pilastered facade and open arcade from building to building will suggest the Spanish inheritance in California architecture."

UNIVERSITY OF CALIFORNIA PUBLICATIONS

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AND THE

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From July 1, 1915, to June 30, 1916

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THE STAFF

BENJAMIN IDE WHEELER, Ph.D., LL.D., President of the University of California.

THOMAS FORSYTH HUNT, D.Agr., D.Sc., Dean of the College of Agriculture; Professor of Agriculture; Director of the Agricultural Experiment Station.

FRANK ADAMS, A.M., Professor of Irrigation Investigations.

R. L. **ADAMS**, M.S., Assistant Professor of Agronomy.

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W. H. **ARNOLD**, B.S., Instructor in Chemistry, Davis.

H. J. **BAADE**, B.S., Instructor in Agricultural Extension, Napa County.

E. B. **BABCOCK**, M.S., Professor of Genetics.

*L. E. **BAILEY**, B.S., Assistant in Soil Chemistry.

H. S. **BAIRD**, B.S., Instructor in Dairy Industry, Davis.

G. **BAROVETTO**, Field Assistant in Viticulture, Davis.

J. T. **BARRETT**, Ph.D., Professor of Plant Pathology in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.

L. D. **BATCHELOR**, Ph.D., Associate Professor of Plant Breeding in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.

W. E. **BATES**, M.D., Lecturer in Hygiene, Davis.

J. R. **BEACH**, D.V.M., Assistant in Veterinary Science, Davis.

S. H. **BECKETT**, B.S., Assistant Professor of Irrigation Practice, Davis.

H. L. **BELTON**, Instructor in Shop Work, Davis.

H. E. **BILLINGS**, M.S., Assistant in Agricultural Chemistry.

F. T. **BIOLETTI**, M.S., Professor of Viticulture and Enology.

DONALD BRUCE, B.A., M.F., Assistant Professor of Forestry.

V. C. **BRYANT**, M.S., Assistant Professor of Agricultural Extension.

Mrs. D. L. **BUNNELL**, Department Librarian.

J. S. **BURD**, B.S., Professor of Agricultural Chemistry.

***CHARLES BURGE**, B.S., Assistant in Animal Husbandry.

*H. M. **BUTTERFIELD**, B.S., Assistant in Agricultural Education.

D. H. **CAREY**, B.S., Instructor in Floriculture and Superintendent of Greenhouses and Gardens.

A. H. **CHRISTIANSEN**, B.S., Instructor in Agricultural Extension, Humboldt County.

A. W. **CHRISTIE**, M.S., Assistant in Agricultural Chemistry.

LILLIAN D. **CLARK**, Instructor in Agricultural Extension.

W. T. **CLARKE**, B.S., Professor of Agricultural Extension and Superintendent of Farmers' Institutes.

*C. P. **CLAUSEN**, B.S., Assistant in Entomology, Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.

R. E. **CLAUSEN**, Ph.D., Assistant Professor of Genetics.

J. E. **COIT**, Ph.D., Professor of Citriculture.

G. A. **COLEMAN**, M.A., Instructor in Entomology and Curator of the Agricultural Museum.

I. J. **CONDIT**, B.S., Assistant Professor of Citriculture.

C. M. **CONNER**, B.S., Instructor in Agricultural Extension, Stanislaus County.

B. H. **CROCHERON**, M.S.A., Associate Professor of Agricultural Extension.

W. V. **CRUESS**, B.S., Assistant Professor of Zymology.

J. B. **DAVIDSON**, M.E., Professor of Agricultural Engineering, Davis.

JOSEPHINE E. **DAVIS**, M.A., Instructor in Nutrition.

*L. M. **DAVIS**, B.S., Assistant Professor of Dairy Industry, Davis.

W. C. **DEAN**, B.S., Assistant in Soil Technology.

J. A. **DENNY**, Foreman in Cereal Work, Davis.

E. R. **DE ONG**, B.S., Assistant in Entomology, Davis.

*V. F. **DOLCINI**, B.S., Assistant in Animal Husbandry, Davis.

W. H. **DORE**, B.S., Assistant Chemist in Fertilizer Control.

J. E. **DOUGHERTY**, B.S., Associate Professor of Poultry Husbandry, Davis.

P. I. **DOUGHERTY**, B.S., Assistant in Agricultural Extension.

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* Resigned.

*H. H. Douglass, M.S., Instructor in Dairy Husbandry.
C. F. Elwood, B.S., Instructor in Agricultural Education.
E. O. Essig, M.S., Assistant Professor of Entomology.
H. S. Fawcett, M.S., Associate Professor of Plant Pathology in Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
F. C. H. Flossfeder, Instructor in Viticulture and Superintendent of Grounds at University Farm, Davis.
S. B. Freeborn, B.S., Instructor in Entomology.
H. B. Frost, Ph.D., Instructor in Plant Breeding in Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
W. F. Gericke, M.S., Assistant Professor of Soil Chemistry.
J. W. Gilmore, M.S.A., Professor of Agronomy.
Joseph F. Grass, Jr., B.S., Assistant in Agricultural Extension.
G. P. Gray, M.S., Instructor in Insecticides and Chemist in Insecticide Laboratory.
J. W. Gregg, B.S., Professor of Landscape Gardening and Floriculture.
J. E. Guernsey, B.S., Instructor in Soil Technology.
R. M. Hagen, B.S., Assistant in Agricultural Extension.
H. M. Hall, Ph.D., Associate Professor of Economic Botany.
C. M. Haring, D.V.M., Professor of Veterinary Science.
R. E. Harmon, B.S., Instructor in Physical Education, Davis.
*R. F. Havens, B.S., Assistant in Poultry Husbandry, Davis.
F. M. Hayes, D.V.M., Assistant Professor of Veterinary Science, Davis.
W. H. Heileman, M.S., Instructor in Agricultural Extension, Glenn County.
A. H. Hendrickson, B.S., Instructor in Pomology.
G. W. Hendry, B.S., Instructor in Agronomy.
W. B. Herms, M.A., Associate Professor of Parasitology.
P. L. Hibbard, B.S., Chemist in Fertilizer Control.
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C. J. Hill, B.L., Assistant in Dairy Testing.
F. E. Hill, Foreman, Forestry Station, Santa Monica.
D. R. Hoagland, M.S., Assistant Professor of Agricultural Chemistry.
W. T. Horne, B.S., Associate Professor of Plant Pathology.
W. L. Howard, Ph.D., Associate Professor of Pomology, Davis.
W. G. Hummel, M.S., Associate Professor of Agricultural Education.
Thomas Francis Hunt, B.S., Assistant Professor of Agricultural Extension and Assistant Superintendent Farmers' Institutes.
Russell R. Ingels, B.S., Assistant in Agricultural Extension.
R. C. Ingrim, Instructor in Shop Work, Davis.
*O. W. Israelsen, M.S., Instructor in Experimental Irrigation, Davis.
J. Jacobson, Foreman of Repairs, Davis.
M. E. Jaffa, M.S., Professor of Nutrition.
Katherine Jones, B.S., Assistant in Landscape Gardening.
T. R. Kelley, A.B., Instructor in English and History, Davis.
W. P. Kelley, Ph.D., Professor of Agricultural Chemistry in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
P. B. Kennedy, Ph.D., Assistant Professor of Agronomy.
O. J. Kern, Assistant Professor of Agricultural Education.
*M. A. Klein, Ph.D., Instructor in Soil Chemistry and Bacteriology.
*J. Koebber, M.S., Instructor in Farm Mechanics, Davis.
George C. Kruetzer, B.S., Instructor in Agricultural Extension, Kern County.
E. J. Lea, M.S., Associate Professor of Nutrition.
C. B. Lipman, Ph.D., Professor of Soil Chemistry and Bacteriology.
W. E. Lloyd, B.S., Instructor in Poultry Husbandry, Davis.
R. H. Loughridge, Ph.D., Professor of Agricultural Chemistry, Emeritus.
Anna M. Lute, A.B., Scientific Assistant, United States Department of Agriculture.
F. F. Lyons, B.S., Instructor in Agricultural Extension, San Joaquin County.
*R. R. Mack, B.S., Assistant in Agricultural Extension, Kern County.
B. A. Madson, B.S.A., Assistant Professor of Agronomy, Davis.
*F. M. Marquis, D.V.M., Assistant in Veterinary Science.
L. K. Marshall, Assistant in Agronomy, Kearney Park.
D. T. Mason, M.S., M.F., Professor of Forestry.
*W. C. Matthews, A.B., Instructor in Scientific Illustration.

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† Died January 8, 1916.

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*__MARGARET MAYBERRY__, Librarian, Davis.
T. C. **MAYHEW**, B.S., Instructor in Agricultural Extension, Madera County.
ELWOOD MEAD, D.E., Professor of Rural Institutions.
W. M. **MERTZ**, Superintendent of Cultivations, Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
W. **METCALF**, A.B., M.S., Assistant Professor of Forestry.
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R. F. **MILLER**, M.S., Assistant Professor of Animal Husbandry, Davis.
J. W. **MILLS**, Assistant in Agricultural Extension, Solano County.
J. N. **MOORE**, Foreman, Forestry Station, Chico.
AGNES FAY MORGAN, Ph.D., Assistant Professor of Nutrition.
D. N. **MORGAN**, B.S., Assistant Professor of Agriculture and Assistant to the Director.
W. **MULFORD**, B.S.A., F.E., Professor of Forestry.
J. W. **NELSON**, B.S., Assistant Professor of Soil Technology.
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*W. F. **OGLESBY**, A.B., Assistant in Viticulture.
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*R. L. **PENDLETON**, B.S., Assistant in Soil Survey.
P. T. **PETERSEN**, D.V.M., Assistant in Veterinary Science, in charge of Serum Manufacture.
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J. T. **ROGERS**, Farm Foreman, Davis.
S. S. **ROGERS**, B.S., Assistant Professor of Olericulture, Davis.
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RICHARD SCHMIDT, Orchardist of University Farm, Davis.
N. P. **SEARLS**, B.S., Instructor in Agricultural Extension, Yolo County.
W. A. **SETCHELL**, Ph.D., Professor of Botany.
L. T. **SHARP**, B.S., Assistant Professor of Soil Chemistry and Bacteriology.
C. F. **SHAW**, B.S., Professor of Soil Technology.
ALFRED SMITH, M.A., Assistant Professor of Soil Technology.
C. O. **SMITH**, M.S., Instructor in Plant Pathology, Whittier.
E. H. **SMITH**, M.S., Assistant Professor of Plant Pathology.
R. E. **SMITH**, B.S., Professor of Plant Pathology.
R. T. **STEVENS**, B.S., Assistant Professor of Landscape Gardening.
G. R. **STEWART**, B.S., Assistant Professor of Agricultural Chemistry.
J. E. **STILES**, B.S., Assistant in Agricultural Extension.
*M. E. **STOVER**, M.S., Instructor in Nutrition.
A. V. **STUBENRAUCH**, M.S., Professor of Pomology.
W. L. **SWEET**, M.S., Assistant in Pomology.
T. **TAVERNETTI**, B.S., Assistant to the Dean of the University Farm School, Davis.
R. H. **TAYLOR**, B.S., Assistant Professor of Pomology, Davis.
*W. J. **TAYLOR**, D.V.M., Assistant Professor of Veterinary Science.
C. D. **THOMAS**, Foreman, Poultry Division, University Farm, Davis.
E. E. **THOMAS**, B.S., Assistant Chemist, Whittier.
J. I. **THOMPSON**, Assistant Professor of Animal Husbandry, Davis.
C. M. **TITUS**, M.A., Instructor in Mathematics, Davis.
J. A. **TRAUM**, D.V.M., Assistant Professor of Veterinary Science.
G. H. **TRUE**, B.S., Professor of Animal Husbandry, Davis.
W. P. **TUFTS**, M.S., Instructor in Pomology, Davis.
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* Resigned.

*E. P. **Van Duzee**, Instructor in Entomology.
E. C. **Van Dyke**, B.S., M.D., Assistant Professor of Entomology.
H. E. **Van Norman**, B.S., Vice-Director of Agricultural Experiment Station, Dean University Farm School and Professor of Dairy Management, Davis.
E. C. **Voorhies**, B.S., Instructor in Animal Husbandry, Davis.
A. E. **Way**, Field Assistant in Viticulture, Fresno, Kearney Park.
H. J. **Webber**, Ph.D., Director Citrus Experiment Station, Dean Graduate School of Tropical Agriculture and Professor of Plant Breeding, Riverside.
H. A. **Weinland**, B.S., Assistant in Agricultural Extension, San Diego County.
W. W. **Weir**, Drainage Expert.
E. J. **Wickson**, Professor of Horticulture, Emeritus.
*C. J. **Wight**, B.S., Instructor in Botany, Davis.
C. J. **Williams**, B.S., Assistant in Agricultural Extension.
*G. H. **Wilson**, B.S., Assistant in Agricultural Extension.
W. W. **Wobus**, B.S., Assistant in Agricultural Education.
F. W. **Woll**, Ph.D., Professor of Animal Nutrition, Davis.
C. W. **Woodworth**, M.S., Professor of Entomology.
H. D. **Young**, B.S., Assistant in Agricultural Chemistry, Whittier.
C. J. **Zinn**, B.S., Assistant in Soil Technology.

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* Resigned.

REPORT OF THE DIRECTOR

BERKELEY, CAL., June 30, 1916.

To the President of the University of California:

As stated in the last annual report, the activities and responsibilities of the Department of Agriculture involving research and instruction, both resident and non-resident, are so varied that it is not feasible each year to review all of them. Last year emphasis was placed upon results obtained, particularly those achievements which have a direct bearing on the agricultural industries of the state. This year the report deals more largely with the administrative features of the department. The aims and problems of administration have been set forth briefly. A list of the bulletins, circulars and scientific papers published during the year and a list of the projects under investigation are given. Brief summaries of some of the achievements of this station have been included. Particular emphasis has been placed upon those research problems which the department has not, for the lack of either time or facilities, thus far been able to undertake. Finally, in the last dozen paragraphs are given some of the concrete items which must be provided if the department is to meet its obligations and carry on the investigations which it is clearly the duty of the state to have done in the interest of its citizens.

Even though the programme is so extensive that it may require years for its development, it seems desirable that the people of California should have these unsolved agricultural problems brought to their attention in order that they may determine how far they desire to provide the means for their solution. The most effective and useful experiment station is not one that takes up problems after the demand for information arises, but one that answers them before the need for the information occurs. A station that is required to comply simply with the popular demand is likely to be superficial and, because ineffective, a disappointment to the very persons who permit their individual interests to interfere with the public good.

FUNCTIONS

It is of the greatest importance that the true functions of the College of Agriculture and the Agricultural Experiment Station be clearly comprehended. Bills introduced into the last state legislature aiming to place upon the Director of the Agricultural Experiment Station of the University duties and responsibilities foreign to the true function of the station is only one of the reasons for the constant reference to this subject.

The function of the Department of Agriculture of the University of California is "the creation and diffusion of knowledge" relating to agriculture. It aims to discover and instruct, but not to control or direct any person's actions. It aims to point out to its constituents the opportunities which the agriculture of California offers, and to teach them how to take advantage of those opportunities. It is not its function to conduct or to interfere in any way with their business.

A Concrete Example.

Take the problem of marketing farm products. The Agricultural Experiment Station may properly seek to discover better methods of packing and standardizing farm products and better ways of transporting those products to the consumer; may study methods of attracting consumers to California products; may seek to discover additional markets so that the farmer may have an opportunity of selling in more than one market, and may study to improve the distribution of products among accessible markets so as to prevent an over-supply or an under-supply in given places. It is not part of its function to take part in the selling of farm products.

In the counties having the Farm Bureau system the Farm Adviser is constantly searching for new markets and new methods of marketing. He keeps a card catalogue of members who have farm products for sale, or who desire to purchase them. When it is found that one member has an article for sale and another wishes to buy a similar article, both members are notified. This closes the incident, so far as the University's officer is concerned. The members of the farm bureau must deal between themselves. The Farm Adviser gives both parties all the information he has, but he cannot transact the sale or take any responsibility concerning it. If the members of the bureau desire to organize a selling or purchasing association, it is the duty of the Farm Adviser to give them such information and counsel as he is capable of giving, advising for or against such an association as circumstances may dictate. He cannot act as agent of any such commercial organization nor accept directly or indirectly any responsibility for its transactions. The station will show a farmer how to spray his trees, how to inoculate his hogs against cholera, or how to map the soil on his farm. Having received the necessary information, the owner must proceed to perform the operations, or employ some one to do it, if the work is to be done. In other words, as soon as the transaction becomes commercial the station's relation to it ceases.

Allen has said that the function of the farmer is to raise things. It is the function of the experiment station to minimize and stabilize the risk.

EXECUTIVE AND POLICE POWERS

In California four functions of government are recognized, i.e., the executive, legislative, judicial, and the educational, which latter includes research. That is to say, it is a government function to acquire and diffuse knowledge. The University and public schools are the agents for acquiring and inculcating this knowledge. Logically, therefore, it is not the function of the university to execute the laws of the state. However, the Director of the Agricultural Experiment Station is charged with police functions in the case of the control and sale of fertilizers and insecticides, and in the production of anti-hog cholera serum, virus and other antitoxins. While the necessary analyses and expert advice concerning matters of this kind should emanate from the station, the execution of the law should obviously be in the hands of an agent directly responsible to the chief executive of the state.

There are many reasons why the station should not be charged with the responsibility for the execution of laws. But the most fundamental one is that all members of the station staff should remain unbiased. They should not be placed in the attitude of an advocate nor have any interest in a decision, beyond stating the scientific truth. In this connection it is strongly urged that a law should be passed exempting members of the station staff from being called into court to give expert testimony in case of litigation between private interests.

THE COUNCIL OF AGRICULTURE

For practical reasons the College of Agriculture has heretofore been conducted by the Department of Agriculture. Through the internal reorganization of the University the Council of Agriculture has acquired this function, thus bringing to the consideration of the problems of the college a larger group of men. The Council of Agriculture consists of the President of the University, the members of the Department of Agriculture of professorial rank, and a representative of each of the departments offering prescribed work in the College of Agriculture. This includes the following departments: Education, History, Political Science, Economics, English, German, Romanic

Languages, Mathematics, Physics, Chemistry, Botany, Zoology, Physiology, Hygiene, Geology and Mineralogy, Pathology and Bacteriology, Drawing and Art, Civil Engineering, Mechanical Engineering, Irrigation, Physical Education, Military Science, and Public Speaking.

The first meeting of the new Council of Agriculture was held on November 29, 1915, with the President of the University presiding and seventy members present.

FOREST INSTRUCTION AND INVESTIGATION

During the year courses of instruction in forestry have been developed and projects of investigation have been outlined. For investigations in this field which have been undertaken or are about to be undertaken see pages 37, 40, 42, 43.

Two four-year courses have been adopted, one in general forestry or silviculture, intended to train students to take positions with the federal or state forestry departments and with consulting foresters and owners of forest properties; and the other in forest utilization, to prepare men as forest or logging engineers. A five-year course has been planned which offers training in both these phases of forestry.

A short winter course of 12 weeks is planned for men employed as guards or rangers in the United States Forest Service, or for men in the employ of lumber companies who desire such training as will enable them to carry on their work more efficiently. Perhaps there is no part of the work in forestry of more significance than the instruction given to students who desire the information, not for professional purposes but as a part of their general education. Last semester there were 353 students pursuing work in forestry with this end in view.

GRADUATE WORK

There has been a marked increase in the graduate work of the Department of Agriculture within the year. The graduate courses have been carefully revised as outlined in the Graduate Announcement. Seventy-two persons have been enrolled, or one-eighth as many graduate as undergraduate students. This increase in graduate students has occurred in spite of the policy of the department not to appoint to assistantships persons who are pursuing graduate work, and not to permit members of the staff to be candidates for degrees.

RESIDENT ENROLLMENT

The enrollment at the University Farm School has doubled in the last three years, having this year reached 314 students, while the graduate and undergraduate students have during the same period increased 30 per cent, having this year reached 637. There were 181 students in attendance upon the Short Courses, making a total attendance of resident students of the College of Agriculture of 1132. Not only the increase in attendance at the University Farm School but also the variation in the preparation of those who attend have created conditions which must be met. It also calls for a settlement of certain policies concerning the future development of the College of Agriculture. Already the number of students per instructor is too large to enable the most efficient individual supervision. Already the University Farm is too small for existing activities. Whether the policy is to go on growing, duplicating instructors and increasing by purchase or lease the farm area, or whether there shall be established another school unit elsewhere as at Kearney Park, in Fresno County, is a question which must be considered seriously in the near future. Assuming its present area, the University Farm School cannot care for a much larger number of farm school students and maintain efficient instruction. This becomes a very important question when the needs of the increasing number of University students who must go to the University Farm School each year is taken into consideration.

During the year three Doctor's degrees, eighteen Master's degrees, eighty-seven Bachelor's degrees, and sixty-three Certificates of Graduation to University Farm School students were granted.

The following is the list of men to whom certificates for completion of a three-year course in agriculture at the University Farm School were given on May 19, 1916, including those finishing their course January 28, 1916.

Hugh Alexander Aiton	Alameda
George Ashley Ambrose	Berkeley
Edgar Horace Axtell	Tombstone, Arizona
Alden Floyd Ayers	Pasadena
Thomas Eustis Balch	Oakland
George Harold Barnes	Orange
*William Frederick Begg	Ventura
Andrew Glassell Brown	Los Angeles
Miles Elliott Burger	Pasadena
Robert William Campbell	Los Angeles
*Louis Rafael Carrigan	Davis
Clark Sterling Cheatham	San Diego
*Ellsworth Allen Colley	Nevada City
Grant Willard Cornell	Watsonville

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* Completed course January 28, 1916.

Harmer William Countryman	San Francisco
Oliver Perry Hazard Crane	Los Angeles
Oliver Crosby	Eagleville
Ralph Martin Davenport	Los Angeles
William Joseph Duffy	San Quentin
John Everett Dugan	Oakland
Wade Vine Fallis	Sierra Madre
*George Emile Fermery	Patchin
Joseph H. Hale	Berkeley
Francis Fischer Hall	Marysville
Parker Louis Hall	Bloomfield
Edward Jay Hampel	Oakland
Joseph Alden Harville	Berkeley
Charles Henry Holmes	Fort Jones
Joseph George Hooper, Jr.	San Francisco
*Mark Douglas Howlett, Jr.	Los Angeles
Jasper Roll Hunsaker	Ducor
Wilfred McDonald James	South Pasadena
Adam Raye Kramar	Silsbee
William David Landels	San Jose
Arthur Gloster Lane	San Diego
Claude Jang Lee	Sacramento
Albert Harlow Lewis	Sacramento
Wentworth Lynch	Centerville
Herbert Hoy Madsen	San Jose
Ghulam Mohammed Malik	Walnut Grove
Kenneth Melrose	San Mateo
Herbert Delmar Miller	Stockton
Frank Wilbur Mitchell	Campbell
Willis Hunting Newton	Oceanside
*Percy Hansford Niestrath	Stockton
*Cecil Cornelius O'Hara	San Francisco
Ralph Abram Painter	Dos Palos
William Guy Pearson	Santa Ana
*Emil Pohli, Jr.	San Francisco
John Montgomery Roberts	Redlands
Harold Marion Rodgers	Watsonville
Benjamin Luther Sharpstein	Alameda
Harvey Benson Smith	Salinas
William Harold Stroud	Los Angeles
Carl Alfred Swanson	Turlock
Theodore Williamson Thomas	Sebastopol
Kenneth Burton Tisdel	Santa Barbara
William Urban	Davis
Ralph Ramsey Vawter	Santa Ana
Hilding Carl Walberg	Hollywood
James Roy Watson	Highland
Ray Nathan Weedmark	Porterville
*Caspar Zweirlein, Jr.	San Francisco

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* Completed course January 28, 1916.

LOCAL INSTRUCTION

Of the 169 students who entered the University Farm School last September for the first time, 100 were high school graduates and 71 were able to offer university entrance requirements, but preferred the briefer course open to them in the University Farm School.

In addition, 40 had some high school training, while 19 had reached the age of 18 without passing beyond the grammar school grades. An analysis of the records of all the students of the University Farm School for the two years ending June 30, 1915, shows that the best records as to conduct and scholarship are to be found among the high school graduates. The next best are found among the group which have had no high school training, while the poorest showing both as to conduct and scholarship is to be found among those young men who have left high school before finishing their work. These facts should emphasize to parents the importance of exhausting all the local opportunities for education before sending their sons away to school.

PRACTICAL FARM EXPERIENCE

Fifteen years ago most of the students in agriculture came from farm homes. Today the majority come from city homes. A questionaire answered by 450 students of the College of Agriculture showed that 41 per cent of the students were brought up on farms, but only 32 per cent came to the university directly from farm homes. The actual amount of full days' farm work for the entire 450 students averaged 19 months, but there were 75 students who, according to their own statements, had never done a full day's work on a farm.

Doubtless many persons think of the University Farm School as a place where farm boys lacking in scholarship go to get some practical training. As a matter of fact the University Farm School students are mostly high school graduates from city homes. The department has made strenuous efforts to find the young man on the farm who has reached the age of 18 without having had the opportunity of high school training. Thus far it has been singularly unsuccessful in reaching this class of young men. These facts serve to emphasize the necessity for some procedure by which graduates of the College of Agriculture shall secure that acquaintanceship with farm life and farm methods which is essential to the success of the agricultural graduate, whether he is to enter commercial agriculture, or one of the many salaried positions to which he is eligible when properly trained.

There are two points of view current concerning this question. One is that it is not a proper subject of instruction, but should be acquired by the student wholly apart from university supervision. The other is that the university should undertake to give this practical instruction in the most approved manner, so that the student has both a knowledge and a skill beyond that which would be obtained under ordinary farm conditions. Probably in the end it will be found that both are necessary. The college will doubtless require a minimum amount of actual farm experience as a prerequisite for graduation, and it will also undertake to have its students actually perform those operations which lend themselves to skillful attainment. All forms of education will doubtless recognize in the future the importance of skill as well as knowledge.

Much thought has been given to this subject by members of the staff, and such a start as present facilities permit has been made in giving students actual experience in farming operations.

CORRESPONDENCE COURSES IN AGRICULTURE

During the year ending April 30, 1916, 7757 students have registered for correspondence courses in agriculture. Previously 15,617 students had registered, making a total of 23,374. However, 5562 reenrollments bring the total number of enrollments in courses now ready up to 28,936. In addition, 1266 students have made application for courses not now ready. During the year 3132 students have completed 3993 courses.

In the table below are listed courses now ready and the number of students who have completed each course during the year ended April 30, 1916.

Poultry Husbandry	830
Swine Husbandry	675
Alfalfa Culture	525
Dairy Husbandry	303
Home Floriculture	280
Citrus Fruits	156
Vegetable Gardening	155
Walnut Culture	140
Onion Culture	139
Barley Culture	122
Olive Growing	111
Almond Culture	110
Canning and Preserving	109
Pear Culture	107
Fig Culture	71

Grape Growing	53
Adult and Child Nutrition	44
Semi-Tropical Fruits	37
Sheep Husbandry	9
Bee Keeping	7
Date Culture	6
Corn Culture	4
	3993

During the year 183,784 pieces of mail matter were sent out in the conduct of the agricultural correspondence courses (exclusive of announcement circulars), of which 65,929 were corrected lesson papers.

FARM BUREAUS

Fourteen counties now have Farm Bureaus completely organized, and thirteen Farm Advisers and three Assistant Farm Advisers have been at work during the year. There are 163 Farm Bureau Centers in California in the thirteen counties in which Farm Advisers are doing work. In addition, Imperial County has a completely organized Farm Bureau in twelve centers. Each is actively at work, although the Farm Adviser has not been appointed.

During the calendar year of 1915 there were held 1452 meetings under the auspices of the Farm Bureaus in the thirteen counties. In addition to this, the Farm Advisers addressed 132 other meetings. The total attendance at all such meetings was 64,144, or an average of 41 per meeting. Based on the work of the year ending December 31, 1915, the Farm Adviser is typically called each week to visit sixteen farms, hold 2.8 meetings with an average attendance of 101, and travels 277 miles.

DEPARTMENTS OF THE FARM BUREAU

Soon after a county farm bureau is organized there is a renewed activity and interest along the several lines of agriculture represented among its members. Even in one farm bureau center there is often a diversity of agricultural interests because the farms turn out diverse products. Thus those of like interest may desire to form subsidiary organizations for more frequent meetings or for more direct work along their specialty. For example, the dairymen may wish to carry on co-operative cow testing, to purchase pure-bred sires, or to market their products; the swine raisers may wish to stamp out hog cholera or to specialize on one breed of hogs; the alfalfa growers may desire to grade uniformly their hay or to store it in co-operatively owned warehouses. These needs are met by the organization of departments within the farm bureau. There may be a "Cow Testing Department," or a "Dairy Department"; a "Swine Breeders' Department"; an "Alfalfa Growers' Department," and others.

Each department organizes with sections in each center wherein there are interested members. Each section in a center has a Farm Bureau Center Committee on Swine Raising (for example), which renders a monthly report at the regular center meeting for the swine raisers' section of the center. This report is transmitted by the center director to the committee of the board of directors, known as the Farm Bureau Committee on Swine Raising, which in turn reports for the whole department at the regular meeting of the Board of Directors. The secretary-treasurer of the farm bureau is secretary and treasurer of all departments and the board of directors are the final court to pass upon all plans and reports of the several departments.

By this means the united agricultural force of the whole county is given to the enterprises undertaken by any department, so that financial, moral and universal backing is given to a group of men who, standing alone as an outside organization, could not find sufficient strength to accomplish effectively the end desired. The several departments may become of prime importance to the members, but if all are kept within the initial county farm bureau organization and, as above, clear their activities through the board of directors, the county can still present a united agricultural front.

INTERMEDIARY COUNTRY LIFE SCHOOLS

The county farm bureaus, through their 175 farm bureau centers, hold regular monthly meetings at schoolhouses, halls and other community centers. Some of these farm bureau centers which find themselves without adequate places of meeting have begun to agitate for the establishment of small community high schools at cross-roads in the country, which shall devote the major portion of their activities to the training of country children for country life. These farm bureau center high schools should have their activities so arranged that the school will find work for its instructors in the vocational subjects throughout the entire twelve months of the year. The plants established by these schools need cost but a few thousand dollars and the land devoted to them need be but a few acres, because the schools will carry on their farm activities upon the farms of the people among whom they are situated. In order that these schools may have a real rural direction they should be led by a principal who is an agriculturally trained man, be directed by a board of farmers who would represent the local farm bureau center, and should be so inexpensive and so democratic in their administration that they may be possible for any moderately prosperous rural community. There is room for perhaps one hundred such farm bureau center high schools in California at places where the large county high schools are distant, or where those schools give no adequate training in rural life.

In the past high school instructors in agriculture have been itinerant in character, going from school to school from year to year, and remaining but nine or ten months in any one community. It is highly desirable that for the future development of California country life these men should become established parts of the country organization in which they are placed; that they should spend the entire calendar year, with a short vacation at Christmas, in forming activities of benefit to their own people; and that these activities should be scattered over the lands round about. In order to demonstrate the feasibility of this plan the Agricultural Extension Division is proposing to the high schools of the state that they should employ these teachers for twelve months a year and should furnish them with adequate transportation in order to reach their work out on the farms. If at least three months a year is spent on agricultural extension activities, and if these activities are under the direction and supervision of the University of California, $200 per year each will be contributed towards the salary of ten of such agricultural instructors during the fiscal year 1916–17 in order that it may serve as a demonstration of the possibility of the plan.

INFLUENCE OF EXTENSION WORK

For the year ending December 31, 1915, 92,000 letters were written by resident members of the staff, many of them in direct answer to inquiries of a technical character. It was hoped that the Smith-Lever Act would relieve the resident teachers and investigators from much of the extension work that has always consumed a large portion of their time and energy. Thus far, however, the field men, instead of relieving this strain, have increased it, because they find so many problems which must be referred to the men who are especially qualified by their investigations to deal with them. The field men have not of course increased the problems; they merely call attention to them. It has also been recognized by members of the staff that during the early years of development under the Smith-Lever Act it is essential for the welfare of the work to give the field men all possible assistance. Nothing but the closest co-operation between all branches of the service will bring about the maximum of efficiency. The department has been fortunate in having this point of view prevail to a high degree among the members of its staff.

UNIVERSITY FARM ACTIVITIES

Some of the minor features of the year's development at the University Farm School are, as a matter of record, given below:

Agricola.—The students established a paper, *The Weekly Agricola,* devoted to the presentation of student activities. It received marked commendation because of the conspicuous attention given to subjects relating to the course of study and a relatively lesser place to athletics and social affairs.

Music.—Under the leadership of Richard Schmidt, those interested in instrumental music organized the University Farm Orchestra, which has given two creditable entertainments and contributed to other activities. Late in the year Homer Henley, a trainer and leader in vocal music, was asked to see what could be accomplished in chorus singing, with the idea of developing something in addition to athletics, around which school spirit could find expression. The response has been so generous and the progress so marked that it is planned to continue the work.

Cafeteria.—The Dining Hall, which has always been the least satisfactory activity of the school, has been changed from the flat rate per month per person to the cafeteria form of service, with very gratifying results.

Picnic.—The management of the annual picnic by a committee of students in consultation with the Dean and a faculty committee has resulted in the development of the picnic into an institution which not only brought this year over 15,000 people to the grounds but furnished also a distinctive training in community service to all students. Aside from the information given the public, it is believed that the training to the students alone justifies the expenditure in time and money.

Change of Calendar.—The first semester next year will end just before Christmas. The second semester will begin immediately after Christmas, instead of about the first of February, as heretofore.

University Farm School Loan Fund.—The wives of the members of the faculty and the ladies of the staff constituting the University Farm Circle have raised a loan fund of $129 in cash and have secured pledges for additional amounts. This fund is to be loaned to students who may need, as sometimes happens, a small amount to complete the current semester's work.

THE BONNHEIM CONTEST

Through the generosity of Albert Bonnheim of Sacramento, a competition has been made possible to the students of the University Farm School. Four Essay prizes of $10 each will be awarded. The winners of the Essay prizes will be required to take part in a Discussion, presenting their essays in the form of public addresses. The Discussion prize will be $50.

The subject for the following year may be any country life topic, such as: Should a rural credit or land settlement system recognize in any way the training which an agricultural graduate receives?

STATE INSTITUTIONS

Over two years ago, at the request of the State Board of Control, visits were made by members of the staff to fourteen of the institutions operated by the state—hospitals, prisons, and homes—for the purposes of studying the agricultural resources and offering suggestions for improvement where possible.

A year ago the visits were repeated and note made of progress resulting from the first year's recommendations.

During the past year aid has been given to twelve institutions by nine different members of the staff, as follows:

Rogers has given special attention to the vegetable situation at Agnews State Hospital; Oglesby to the olives at Whittier State Home; Gregg to the landscape design of the new Ventura Home for Girls, to preparing a complete revised landscape plan for the Whittier State School, and to aiding in the landscape work at the Preston School; Taylor to the future orchard policy of the Berkeley Home for the Deaf and Blind; Dougherty to the establishment of up-to-date poultry plants at the Sonoma State Home and Southern State Hospital, to reorganizing the poultry industry at Folsom Prison, and, with Beach, to controlling poultry diseases at the Stockton State Hospital; Davidson to the silos and silage crops at the Napa State Hospital; Woll to feeding stock at Sonoma State Home, Stockton State Hospital, Southern State Hospital, and Veteran's Home, and to machine milking of dairy herds; R. L. Adams to the farming operations at Mendocino State Hospital, Stockton State Hospital, Napa State Hospital, Sonoma State Home, to the acquisition of new lands by the Agnews State Hospital, and to the orchard situation at the Berkeley Home for the Deaf and Blind.

Following a conference with the State Board of Control, plans by R. L. Adams are now under way for a system of regular reports covering the monthly agricultural operations at the various state institutions. These reports will come to the University, where they will be compiled and deductions drawn for the standardization of present operations and possible betterment of conditions. This study will extend to all forms of agricultural activities—field crops, fruits, vegetable gardens, dairies, hogs and poultry—and will result in over fifty foremen reporting the work of more than eighty departments. By making a proper systematic study of operations and production month by month substantial recommendations for greater results and more economical handling will be possible.

HILGARD HALL

Through the bond issue provided by the initiative vote of the people of California in 1914 the Regents have been able to set aside $350,000 for the second unit to the Agricultural College group. This unit has been officially named Hilgard Hall, in honor of the late Dr. Eugene Woldemar Hilgard, first director of this station, for more than forty years professor in the University of California, and a soil student of rare distinction.

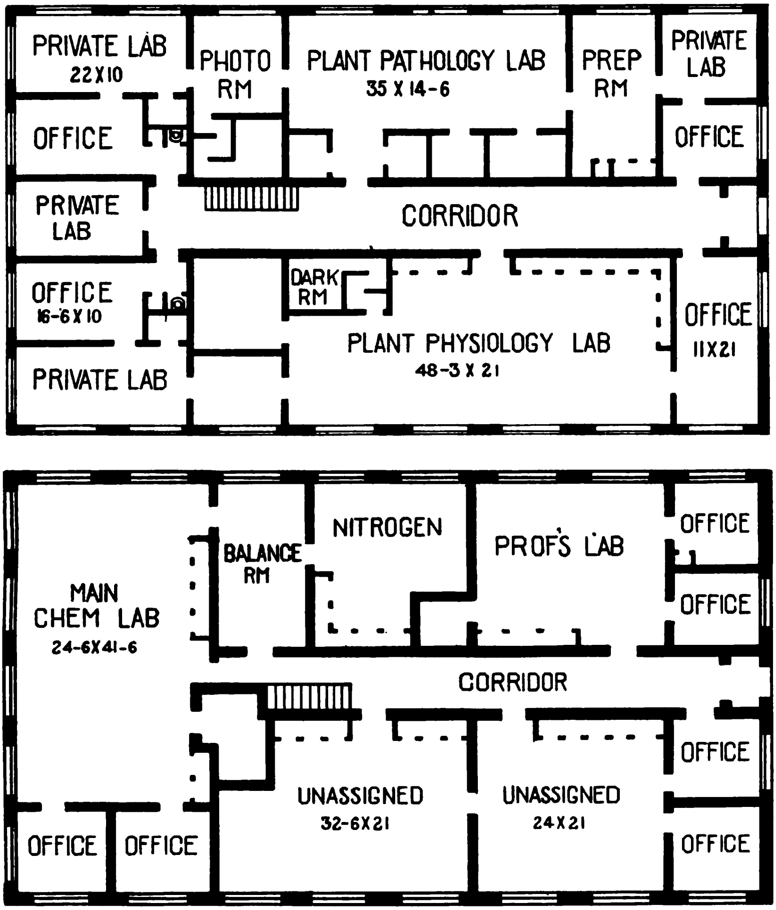
It is of interest to note that in 1879, through the efforts of Dr. Hilgard, the State Legislature of California made its first appropriation for experiments in agriculture of $5000, or $2500 per year. During the last four years the California State Legislature has made available an annual appropriation of $350,000 for research and educational work in agriculture, and, through the gift of the people of California, as stated above, the Regents are enabled in addition to dedicate a building to Dr. Hilgard, which is to cost $350,000.

Hilgard Hall is to be the headquarters of seven divisions of the Department of Agriculture, namely, Agronomy, Citriculture, Forestry, Genetics, Pomology, Soil Technology, and Viticulture. The building is to be of reinforced concrete, will have four floors, and will contain six classrooms, sixteen laboratories, and about fifty offices. Special equipment has been provided for the various types of work of the several divisions, as, for example, cold storage rooms for the study of the handling and marketing of fruit. One room has been set aside for a "Conversation Room," and a suite has been arranged where the smaller societies and groups of students of the College of Agriculture may hold meetings.

THE BUILDINGS OF THE CITRUS EXPERIMENT STATION AND GRADUATE SCHOOL OF TROPICAL AGRICULTURE

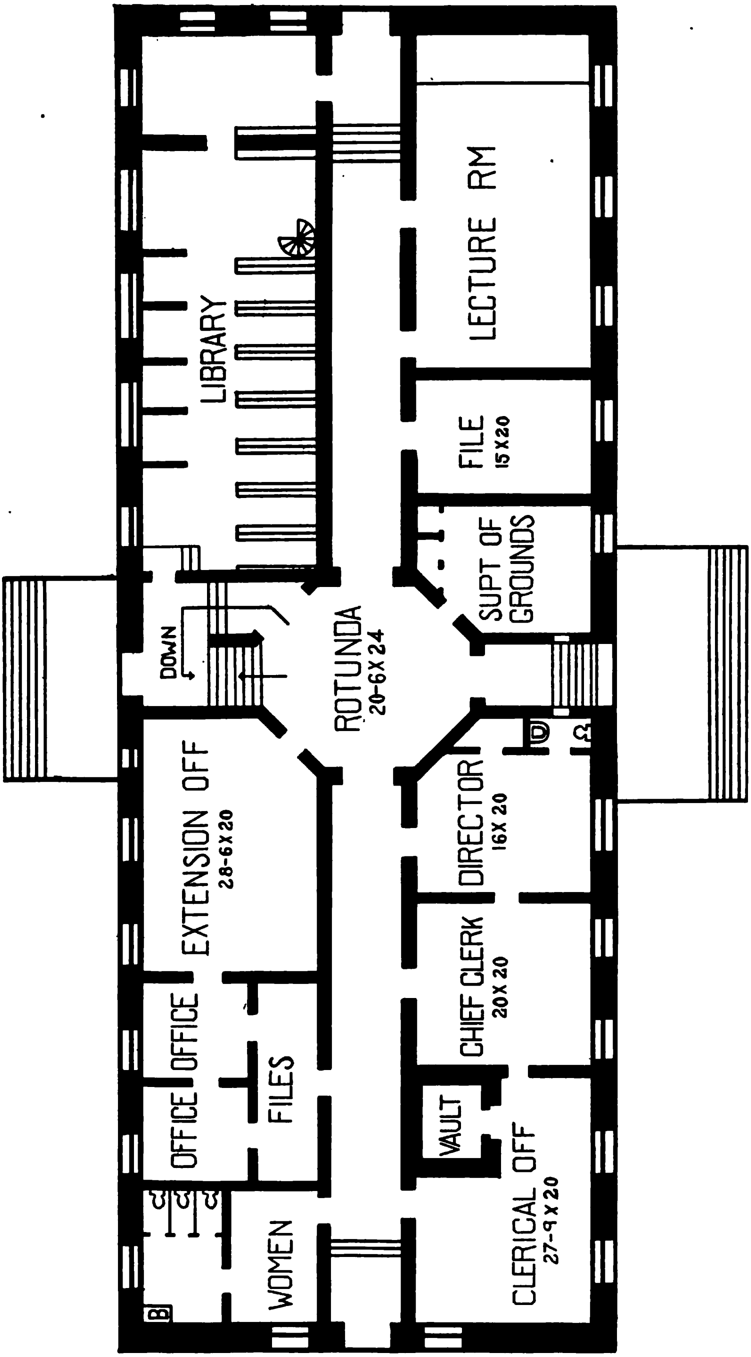
The legislature of 1913 provided a fund of $60,000 for the purchase of suitable lands as a site for the Citrus Experiment Station and Graduate School of Tropical Agriculture, and also appropriated $100,000 for laboratory buildings and $25,000 for director's residence, barns and other minor buildings. A site two and one-half miles from the center of the city of Riverside, containing 475 acres, was selected and purchased by the Regents of the University for this institution, and the buildings provided for rae now in course of construction.

The laboratory buildings, a sketch of which is reproduced herewith, will be located on the station site in a commanding position at the base of a rocky peak, several hundred feet in height. The location of the laboratories is considerably higher than the surrounding valley and affords a magnificent view over the city of Riverside. The buildings, which are to be constructed of brick and cement, will be plastered on the exterior. The broad, overhanging, tiled roofs, plastered walls, arched doorways and massive pilastered facade and open arcade from building to building will suggest the Spanish inheritance in California architecture.

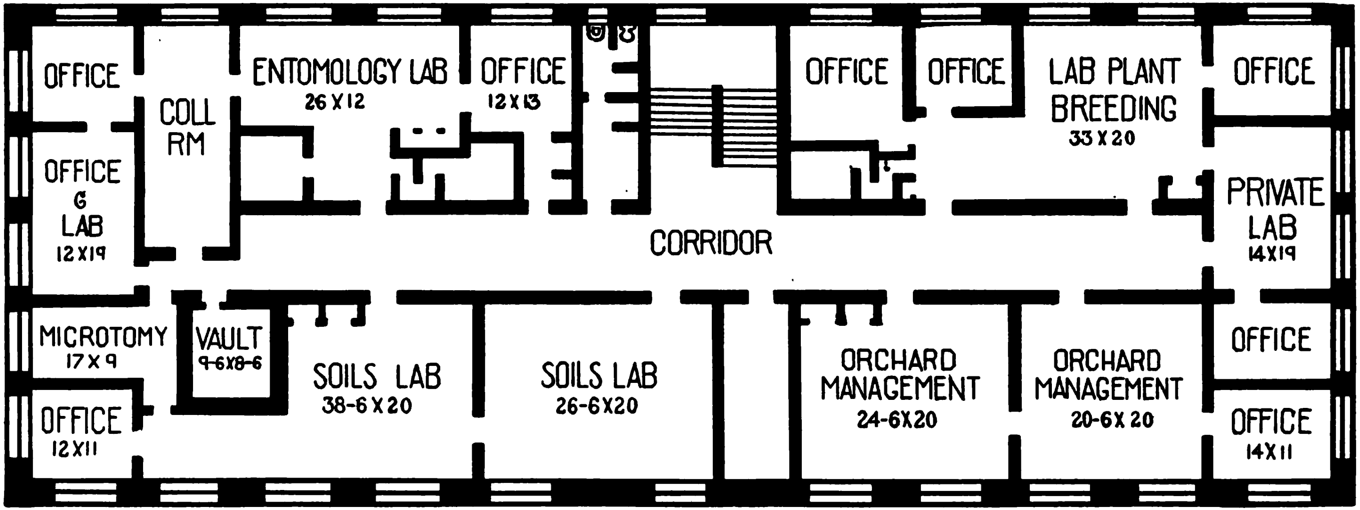


The floor plans of the new wings of the laboratory group of buildings of the Citrus Experiment Station, Riverside.

"The south wing (upper plan) is to house the divisions of plant pathology and plant physiology, and the north wing (lower plan) the division of agricultural chemistry."



The first floor plan of the main building of the laboratory group of the Citrus Experiment Station, Riverside. "On the first floor are to be located the administration offices, public service offices, library, and general lecture room."



The second floor plan of the main building of the laboratory group of the Citrus Experiment Station, Riverside.

"The second floor will contain laboratories and offices for the divisions of entomology, plant breeding, and orchard management."

The group of laboratory buildings will comprise a main building, 154 feet by 57 feet, and two wings each 100 feet by 55 feet. The basement of the main building will contain the boiler and engine room, seed storage rooms, kitchen, library book stacks, etc. On the first floor are to be located the administration offices, public service offices, library, and general lecture room. The second floor will contain laboratories and offices for the divisions of entomology, plant breeding and orchard management. The south wing is to house the divisions of plant pathology and plant physiology, and the north wing the division of agricultural chemistry.

The residence of the Director of the Citrus Experiment Station, Riverside.

A special effort has been made in planning the buildings to secure the proper facilities for carrying on research work. The laboratories will be well lighted and provided with gas, water, electricity for power and light, compressed air and suction.

Aside from the laboratory buildings, there are also under construction a director's residence, superintendent's residence, barn, farm office and tool room. The director's residence, a sketch of which is reproduced herewith, is to occupy a high, rocky knoll, commanding a view over a large portion of the farm.

The construction work also in progress includes the installation of a well, two pumphouses, two reservoirs, and the necessary pipe lines to provide for domestic and irrigation water.

While the construction work is in progress, plans are being perfected as rapidly as possible for the experimental work. About 125 acres were prepared and planted in grain last spring to test the uniformity of the land and get it into condition. Ten acres have been planted in apricots and pears as a part of a series of experiments in pruning.

BULLETINS AND CIRCULARS

During the year there have been published thirteen Bulletins and twenty Circulars in addition to the Director's Annual Report. In the aggregate about a million copies have been printed, of which 820,000 have been distributed. The policy adopted by the Secretary of the Regents in sending brief reports of investigational work to the daily and weekly press has resulted in a greatly increased demand for bulletins and circulars, as well as an ever increasing request for information by letter. The mailing list has increased from 26,000 to 31,000 addresses. The California list, comprising individuals, newspapers and libraries, is over 25,700. The so-called Eastern list, sent to persons in any state outside California, is 4600, while the foreign list numbers about 900.

In accordance with law, bulletins and circulars are sent free upon request to any citizen of the state, but no person is placed permanently upon the mailing list until he has made the request in writing and has stated the subjects upon which he desires bulletins and circulars. For convenience, a card is sent to each applicant, bearing a segregation of the groups of subjects on which bulletins and circulars may be obtained, as follows:

1. Field Crops, Forage and Root Crops.
2. Vegetable Gardening and Small Fruits.
3. Landscape Gardening and Floriculture.
4. Deciduous Fruits and Nuts: Apples, Pears, Peaches, Prunes, Apricots, Almonds, Walnuts.
5. Citrus and Semi-Tropical Fruits: Oranges, Lemons, Figs, Dates, Olives.
6. Grapes: Raisin, Wine and Shipping Grapes.
7. Animal Industry: Beef Cattle, Sheep, Hogs, Horses.
8. Dairy Industry: Dairy Cattle, Milk, Butter, Cheese.
9. Poultry.
10. Apiculture.
11. Forestry.

This system prevents in some degree sending publications to persons who are not interested in them, thus saving expense to the institution and annoyance to the person receiving them. The problem of the economic and efficient distribution of the publications of the station is, however, a difficult one.

The number, title and author of bulletins and circulars published since the last report are stated below.

BULLETINS

Bul. 257. New Dosage Tables. C. W. Woodworth.
Bul. 258. Mealy Bugs of Citrus Trees. C. P. Clausen.
Bul. 259. Commercial Fertilizers. P. L. Hibbard.
Bul. 260. The Determination of Availability of Nitrogenous Fertilizers in Various California Soil Types by their Nitrifiability. C. B. Lipman and P. S. Burgess.
Bul. 261. Melaxuma of the Walnut "Juglans Regia." H. S. Fawcett.
Bul. 262. Citrus Diseases of Florida and Cuba compared with those of California. H. S. Fawcett.
Bul. 263. Size Grades for Ripe Olives. F. T. Bioletti.
Bul. 264. The Calibration of the Leakage Meter. C. W. Woodworth.
Bul. 265. Cottony Rot of Lemons in California. C. O. Smith.
Bul. 266. A Spotting of Citrus Fruits due to the action of Oil Liberated from the Rind. H. S. Fawcett.
Bul. 267. Experiments with Stocks for Citrus. W. W. Bonns and W. M. Mertz.
Bul. 268. Growing and Grafting Olive Seedlings. F. T. Bioletti and F. C. H. Flossfeder.
Bul. 269. Phenolic Insecticides and Fungicides. G. P. Gray.

CIRCULARS

Cir. 133. The County Farm Adviser. B. H. Crocheron.
Cir. 134. Control of Raisin Insects. F. T. Bioletti.
Cir. 135. Official Tests of Dairy Cows. F. W. Woll and Cora J. Hill.
Cir. 136. Melilotus Indica as a Green Manure Crop in Southern California. W. M. Mertz.
Cir. 137. Wood Decay in Orchard Trees. W. T. Horne.
Cir. 138. The Silo in California Agriculture. F. W. Woll.
Cir. 139. The Generation of Hydrocyanic Acid Gas in Fumigation by Portable Machines. H. D. Young.
Cir. 140. The Practical Application of Improved Methods of Fermentation in California Wineries during 1913 and 1914. F. T. Bioletti and W. V. Cruess.
Cir. 141. Standard Insecticides and Fungicides vs. Secret Preparations. G. P. Gray.
Cir. 142. Practical and Inexpensive Poultry Appliances. J. E. Dougherty and W. E. Lloyd.
Cir. 143. Control of Grasshoppers in Imperial Valley. W. E. Packard.
Cir. 144. Oidium or Powdery Mildew of the Vine. F. T. Bioletti and F. C. H. Flossfeder.
Cir. 145. Suggestions to Poultrymen Concerning Chicken-pox. J. R. Beach.
Cir. 146. Jellies and Marmalades from Citrus Fruits. W. V. Cruess.
Cir. 147. Tomato Growing in California. S. S. Rogers.

Cir. 148. Lungworms. W. B. Herms and S. B. Freeborn.
Cir. 149. Lawn Making in California. J. W. Gregg.
Cir. 150. Round Worms in Poultry. W. B. Herms and J. R. Beach.
Cir. 151. Feeding and Management of Hogs. J. I. Thompson.
Reprint Cir. 113. Correspondence Courses in Agriculture.

PROBLEMS UNDER INVESTIGATION

In the last annual report attention was called to the fact that California consists of an area equal to the nine north Atlantic states, which have ten agricultural experiment stations; that this station has practically all the problems of those ten stations; that, in addition, it has the problems growing out of the use of water in an arid country, and that most of the agricultural investigators in America and Europe work with the problems of a humid climate. Hence the members of this station are largely following an uncharted field, with the result that they are constantly outlining and attempting to solve more problems than their time or resources will permit.

This state of affairs continues to exist. Up to the close of last year 366 projects had been outlined. This year 90 projects have been added. During the year data have been collected on 170 of these projects, as shown in the following list:

No. 5. The Immunization of Calves to Tuberculosis with "Bovovaccine". By C. M. Haring, J. Traum, reporting to C. M. Haring.
No. 16. A Systematic Study of the Important So-called Physiological Diseases of Plants Occuring in California. By Ralph E. Smith; at Berkeley and various field stations; Van Nuys and Roosevelt (Internal Brown Streak of Potato); Oroville (Exanthema); Stockton and vicinity (Little Leaf). Begun July 1, 1913.
No. 22. A study of Hybrids of 1st, 2nd and 3rd Generations. Between Various Species of Nicotina both Wild and Cultivated. By W. A. Setchell.
No. 24. A Study of Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California. By C. M. Haring, C. L. Roadhouse and Jacob Traum, reporting to C. M. Haring, at Berkeley and elsewhere in California. Begun January 2, 1914.
No. 25. A Chemical, Biological and Physiological Study of Alkali in Soils in its Relations to Crop Production. By L. T. Sharp, reporting to Charles B. Lipman; at Davis, Berkeley and Kearney Park. Begun August 13, 1913.
No. 28. A Continuation of Past Studies on the Lime-Magnesia Ratio for Plants, Particularly Oranges. By W. F. Gericke, reporting to Charles B. Lipman. Begun August, 1911. Completed.
No. 30. Fundamental Studies on the Antagonism between Salts as Measured by Bacterial Efficiency in Soils. (Continuation of Past Studies.) By C. B. Lipman. Begun December, 1908. Completed.

No. 34. Co-operative Experiments in the Control of Bovine Tuberculosis. By Jacob Traum, reporting to C. M. Haring; at Berkeley and elsewhere in California. Begun August 8, 1913.

No. 51. Reclamation of Alkaline Lands by Flooding and Tile Drainage Investigations. Office of the Experiment Stations, United States Department of Agriculture, at Fresno, California, SE ¼ Sec. 6, T. 14 S, R. 19 E. By C. F. Shaw and W. W. Weir, reporting to C. F. Shaw. Begun June 9, 1913.

No. 52. Hog Cholera; its Prevalence and Prevention in the Imperial Valley. By W. J. Taylor, reporting to C. M. Haring; at Imperial Valley. Begun February, 1914.

No. 61. Certified Dairy Inspections. By C. L. Roadhouse and W. H. Stabler, reporting to C. M. Haring; at various certified dairies. Begun January 1, 1914.

No. 62. Tuberculin Testing of Cows in Certified Dairies. By C. L. Roadhouse, reporting to C. M. Haring. Begun March, 1914.

No. 63. Bacteriological Examinations of Certified Milk. By C. L. Roadhouse, reporting to C. M. Haring. Begun January, 1914.

No. 64. Drainage of Irrigated Lands by Pumping from Sump without Tile. By W. W. Weir and L. K. Marshall, reporting to Charles F. Shaw; work located at Fresno, California, Experiment Station Tract. Begun September 30, 1913. Completed.

No. 78. Variety of Trials of Grain. By W. E. Packard, reporting to J. W. Gilmore; at Imperial Valley Experiment Station. Begun January, 1914.

No. 79. Crop Production and Soil Management in Relation to Climatic Conditions in Imperial Valley Station. By Walter E. Packard, reporting to J. W. Gilmore. At Imperial Valley. Begun January, 1914.

No. 82. Crop Production and Soil Management in Relation to Soil Type at Imperial Valley Station. By Walter E. Packard, reporting to J. W. Gilmore. Begun January, 1914.

No. 83. Manure Experiments. By Walter E. Packard, reporting to J. W. Gilmore. Begun June, 1914.

No. 84. Miscellaneous Plantings. By Walter E. Packard, reporting to J. W. Gilmore. At Imperial Valley Experiment Station. Begun November, 1913.

No. 86. Culture Methods for Alfalfa when Used for (1) Pastures, (2) For Hay Production. By Walter E. Packard, reporting to J. W. Gilmore. Imperial Valley Experiment Station. Begun November, 1913.

No. 88. Veterinary Survey of Selby Smelter Zone for the Selby Smelter Commission. (In co-operation with Dr. K. F. Meyer of Pathology Department.) By K. F. Meyer, C. M. Haring, and William La Grange. At land between Vallejo and Benicia. Pathological work at Berkeley. Begun October, 1913. Final report, January 10, 1916.

No. 89. Walnut-Oak Hybrids; Study of a New Form of Juglans Californica; Teratology in Juglans Californica; Allied Problems. By E. B. Babcock. Begun March, 1908.

No. 91. Metabolism of Fresh Milch Cows. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True; at University Farm, Davis. Begun December, 1913.

No. 92. A Study of the Effects of Alfalfa as Exclusive Food in the Development of the Dairy Calf and Heifer for Dairy Purposes. By F. W. Woll and Edwin C. Voorhies, reporting to Gordon H. True. Begun March, 1914.

No. 96. Improvement of Bearing of Vine Varieties by Selection. By F. C. H. Flossfeder, reporting to Frederic T. Bioletti. Begun 1910.

No. 97. Tests of New or Little Known Varieties of Vines. By F. T. Bioletti. Begun December, 1913.

No. 98. Resistant Stocks for Californian Vines. By F. C. H. Flossfeder, reporting to Frederic T. Bioletti; at Davis. Begun 1910.

No. 100. Disinfection of Roots and Cuttings with Hot Water. By F. T. Bioletti. Project completed.

No. 103. Relation of Degree of Maturity of Grapes to Quantity and Quality of Raisins. By A. E. Way, reporting to Frederick T. Bioletti. At Kearney Park. Begun December, 1913.

No. 104. Resistant Stocks for Raisin Varieties. By A. E. Way, reporting to Frederic T. Bioletti. At Kearney Park. Begun 1911.

No. 105. Wine Grapes for the San Joaquin Valley. By A. E. Way, reporting to Frederic T. Bioletti. Begun December. 1913.

No. 108. Coatings for Cement Wine Vats. By W. V. Cruess, reporting to Frederic T. Bioletti. At Berkeley.

No. 110. Improvement of Methods of Preparing Unfermented Grape Juice. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1913.

No. 111. Standards of Composition of California Grapes and Wine. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun December, 1913.

No. 113. Methods of Germinating Olive Seeds. By W. F. Oglesby, reporting to Frederic T. Bioletti. Begun December, 1913. Project completed.

No. 114. Preparation of Collection of Olive Trees at Davis, Kearney and Imperial, and of specimens at Berkeley. By W. F. Oglesby, reporting to Frederic T. Bioletti. At Berkeley and Davis. Begun March, 1914.

No. 115. Improvement of Methods of Pickling Olives. By W. F. Oglesby, reporting to F. T. Bioletti. Begun December, 1913.

No. 116. A Study of *Armillaria Mellea,* with the Purpose of Finding Practicable Ways to Put an End to Loss from this Fungus among the Trees and Shrubs Attacked by It. By W. T. Horne, reporting to Ralph E. Smith. Begun December, 1913.

No. 117. Minor Investigations in Plant Pathology. By Miss E. H. Smith, reporting to Ralph E. Smith. Begun December, 1913.

No. 118. A Study of Bacterial Disease of Olives Known as Olive Knot with the Purpose of Discovering the Method of Dissemination of Causative Organism and the Conditions Governing Inspection, the perfecting of a Practical Method of Control or Eradication and Study of the Pathological Changes Connected with the Knot Formation. By W. T. Horne, reporting to Ralph E. Smith; at Berkeley and Fairoaks. Former Plant Pathology Project No. 10, commenced in previous years.

No. 122. A Study of the Factors Influencing Seed Formation in Citrus Fruits. By J. Eliot Coit and Carl Nichols. Commercial Orange and Lemon Orchards near Whittier, Riverside and Berkeley. Other places to be decided upon. Begun April, 1911.

No. 124. Studies of the Feed Requirements and Milk Production of Milch Goats: (*a*) On the Value of Grain Feeds for Goats Fed Alfalfa Hay. By F. W. Woll and E. C. Voorhies, reporting to Gordon H True, University Farm, Davis. Begun February, 1914.

No. 158. The Pollination of Domestica and Triflora Plums Under California Conditions. By A. H. Hendrickson, reporting to A. V. Stubenrauch. At Davis, and commercial orchards in representative sections of the State. Begun January, 1914.

No. 159. Student Laboratory Plantings: A Study of Fruit Tree Stocks, Pruning and Planting Methods. By members of the teaching staff, reporting to A. V. Stubenrauch; at University Farm, Davis. Begun November, 1913.

No. 160. Death of Animals and Cases of Serious Sickness at University Farm, Davis. By F. M. Hayes, reporting to H. E. Van Norman. Begun January 9, 1914.

No. 161. Weekly Report of Work in Progress at University Farm by Farm Division Repairs and Power Division and Grounds. By T. Tavernetti, reporting to H. E. Van Norman. Begun January, 1914.

No. 164. Soil Survey of the San Diego Area. By L. C. Holmes and R. L. Pendleton, reporting to C. F. Shaw. Southern California, between Pacific Ocean and the 116° 30′ W meridian and between the Mexican boundary and 30° 30′ parallel of latitude. Begun February 1, 1914; completed July 1, 1915.

No. 168. Influence of Rotation upon Crop Production Power of the Soil Without Treatment. L. K. Marshall, reporting to J. W. Gilmore. At Kearney Park.

No. 173. Fertilizer Experiment. By B. A. Madson, reporting to J. W. Gilmore; at University Farm, Davis. Continuation of the work of several years past.

No. 174. Rotation Experiments. By B. A. Madson, reporting to J. W. Gilmore; at University Farm, Davis. Begun November, 1913.

No. 175. Seed Exchange Experiment. By B. A. Madson, reporting to J. W. Gilmore. Continuation of the work begun in 1907.

No. 176. Variety Trials with Wheat, Barley and Oats in Plots. By B. A. Madson, reporting to J. W. Gilmore. Continuation of work carried on for a number of years.

No. 180. An Experiment to Determine the Cost of Fitting Beef Cattle for the Show-ring. By Gordon H. True and V. F. Dolcini, reporting to Gordon H. True; at University Farm, Davis. Begun January, 1914.

No. 182. Investigation of the Nature and Commercial Value of the Proximate Principles and Distillation Derivatives Present in the Principal Varieties of California Kelps. By D. R. Hoagland and others, reporting to John S. Burd. Begun January, 1914. This project has been completed.

No. 183. Investigation of the Agricultural Value of the Major Fertilizing Constituents of Kelp—Nitrogen and Potash. By G. R. Stewart and others, reporting to John S. Burd. Begun January, 1914. This project has been completed.

No. 186. The Practicability of Growing Vegetables on the University Farm. By S. S. Rogers, reporting to H. E. Van Norman; at University Farm, Davis. Begun January 1, 1914.

No. 187. Almond Culture. By R. H. Taylor, reporting to A. V. Stubenrauch. Work carried on at the University Farm, Davis, and commercial orchards in representative districts. Begun April, 1914.

No. 193. The Effect of Different Stocks on Commercial Species and Varieties of Citrus. By W. W. Bonns and W. M. Mertz, reporting to H. J. Webber. Series 1, Citrus Experiment Station, Riverside; Series 2, New Site of Citrus Experiment Station and elsewhere as nature of work proves desirable. Begun April, 1907.

No. 197. Study of the Comparative Infectiousness of the Crown Gall Organism (Bacterium tumefaciens), with special reference to Finding Resistant Forms of Prunus Suitable as a Root Stock for the Various Stone Fruits. By C. O. Smith, reporting to H. J. Webber. Work carried on at Whittier. Begun March, 1910.

No. 198. Lemon Decay Fungi, with Special Reference to Their Control by Wash Water Disinfection. By C. O. Smith and E. E. Thomas, reporting to H. J. Webber. Work carried on at Whittier, California, as headquarters, with experiments and observation over all of Southern California. Begun April 8, 1911.

No. 199. Black Pit of Lemons. By C. O. Smith, reporting to H. J. Webber. At Whittier Pathological Laboratory. Begun May, 1912.

No. 250. Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and Other Fruit Trees. By H. S. Fawcett, reporting to H. J. Webber. At Whittier, Santa Paula, Chula Vista, Riverside. Begun February, 1912.

No. 253. Some Studies on Mottling of Citrus Trees. By J. T. Barrett, reporting to H. J. Webber. At Riverside and various other locations. Begun April, 1914.

No. 258. The Nematode Problem on Citrus Trees. By E. E. Thomas, reporting to H. J. Webber. Work carried on at Whittier, Riverside and various points in Southern California. Begun December, 1912.

No. 260. A Study of the Relative Influence of Different Factors on the Composition of Certain Fruits and Nuts. By H. D. Young, reporting to H. J. Webber. At Riverside and Whittier. Begun January, 1913.

No. 261. The Breeding and Improvement of Citrus Fruits. By H. J. Webber, H. B. Frost, reporting to H. J. Webber. At Citrus Experiment Station, Riverside, California. Begun October, 1913.

No. 263. The Origin, Nature and Inheritance of Apparent Mutations in Certain Plants. By Howard B. Frost, reporting to H. J. Webber. At Citrus Experiment Station, Riverside, California. Begun October, 1913.

No. 265. Citrus Survey. By C. S. Milliken and A. R. Tyler, reporting to H. J. Webber, Citrus Experiment Station, Riverside, California. Begun April, 1914.

No. 268. Studies in Silage Production: (*a*) Changes in chemical composition of alfalfa, oats, sorghum, kafir and milo during the siloing process; (*b*) Losses of dry matter and its components in the siloing process in the case of the preceding crops. By F. W. Woll and M. E. Jaffa, reporting to Gordon H. True. Begun May, 1914.

No. 269. The Influence of Barley on the Milk Secretion of Cows. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. Begun May, 1914.

No. 270. Improvement of Wheat, Barley and Oats by the Centgener Method. By B. A. Madson, reporting to J. W. Gilmore. Begun March, 1914.

No. 271. Triangular Soil Exchange Experiment. By B. A. Madson, reporting to J. W. Gilmore. Begun November, 1913.

No. 272. Variety Trials with Field Peas and Eight Vetches. By B. A. Madson, reporting to J. W. Gilmore. Begun February, 1914.

No. 273. Variety Trials with Wheat, Oats and Barley in Rows. By B. A. Madson, reporting to J. W. Gilmore. Begun February, 1914.

No. 275. A Study of the Milk and Cream Supply Furnished to University Farm Creamery, University Farm, Davis, with the Object of Working Out a System of Grading and Paying for Quality. By H. H. Douglas, reporting to L. M. Davis. Begun July, 1914.

No. 281. Cultural Experiments with Cotton. By W. E. Packard, reporting to J. W. Gilmore. At Imperial Valley Experiment Station. Begun August, 1913.

No. 282. Sudan Grass Experiment. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1913.

No. 283. Experiments with Non-Saccharine Sorghums, Saccharine, Sorghums and Broomcorn. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1914.

No. 284. Corn Experiments. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1914.

No. 285. Potato Experiments. By B. A. Madson, reporting to J. W. Gilmore. Begun May, 1914.

No. 286. Bean Experiments. By B. A. Madson, reporting to J. W. Gilmore. Begun February, 1914.

No. 287. Culture Experiments with Cow Peas and Soy Beans. By B. A. Madson, reporting to J. W. Gilmore. Begun April, 1914.

No. 293. Studies in Jelly Making. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1914.

No. 296. Effect of Low Temperature of Sterilization on Quality of Canned Fruits. By W. V. Cruess, reporting to Frederic T. Bioletti. Begun August, 1914.

No. 297. Collection of Data to Aid in the Establishment of Standards for Wine, Raisin and Shipping Grapes. By F. T. Bioletti. Begun August 8, 1914.

No. 302. A Study of the Value of Cooling Immediately After Drawn, Milk which is to be Held Over Night for Cheese Making the Following Day. By H. S. Baird, reporting to L. M. Davis. Begun November, 1914.

No. 303. A Study of Date Seedlings of Known Parentage Reared from Cross-Pollinated Seed. By J. Eliot Coit and Walter E. Packard. At Meloland and Berkeley. Begun April, 1908.

No. 305. The Avocado. By I. J. Condit and J. E. Coit. Begun October, 1915.

No. 307. Agronomical Plant Collection. By P. B. Kennedy, reporting to J. W. Gilmore. Begun January, 1914.

No. 311. Investigation to Find the Relative Values of Meat Scrap, Digester Tankage, Blood and Bone Meal, Soy Bean Meal, O. P. Linseed Meal, Cocoanut Oil Cake Meal, and Alfalfa Meal as Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty. Begun December, 1914.

No. 312. Investigation of Roup (Avian Diphtheria) and Chicken-pox (Epithelioma Contagiosum). By J. R. Beach, reporting to C. M. Haring. Begun July 1, 1914.

No. 313. A Report of Inquiries from Poultry Raisers of California in Regard to Outbreaks of Disease among Their Flocks. By J. R. Beach, reporting to C. M. Haring. Begun June 22, 1914.

No. 314 Co-operative Extension Work in the Prevention of Hog Cholera in Co-operation with the U. S. Department of Agriculture. By members of the Veterinary Division in co-operation with Dr. B. J. Cady. Begun September 25, 1914.

No. 315. Investigation of the Possibility of the Extensive Feeding of Alfalfa Being a Cause of Barrenness. By C. M. Haring. Begun September, 1914.

No. 316. On the Value of Silage from Saccharine and Non-Saccharine Sorghums for Fattening Sheep on Alfalfa. By R. F. Miller, reporting to Gordon H. True. Begun December, 1914.

No. 317. Studies of Calf Feeding Problems with Special Reference to California Conditions: (1) On the Value of Oil Meal in Grain Mixtures for Skim Milk Calves. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. Begun October, 1914. This project has been completed.

No. 318. The Health of Young Calves as Influenced by Various Systems of Feeding. By C. L. Roadhouse, assisted by J. N. Fulmore and F. E. Gillam. Begun August 17, 1914.

No. 319. Cost of the Manufacture of Olive Oil and Pickles in California. W. F. Oglesby, reporting to F. T. Bioletti. Begun December, 1914.

No. 320. A Study of the Control of Mould Development in the Cheese-Curing Rooms, Dairy Building, University Farm, Davis. By B. S. Baird, reporting to L. M. Davis. Begun December, 1914.

No. 324. Unfermented Lemon Juice. By W. V. Cruess, reporting to F. T. Bioletti. Begun December, 1914.

No. 328. A Study of the Factors Affecting Swell in Ice Cream. By H. S. Baird, reporting to L. M. Davis.

No. 330. A Study of the Underlying Factors Influencing Soil Fertility as Evidenced by the Chemical Composition of the Soil Solution. By G. R. Stewart and others, reporting to J. S. Burd. Begun December 15, 1914.

No. 332. Methods of Preparing Fruit Juices. By W. V. Cruess, reporting to F. T. Bioletti. Begun January, 1915.

No. 333. Effect of Cross-Pollination of Muscat in Vineyard. By F. T. Bioletti. Begun January, 1915.

No. 336. A Study of the Chemical and Physical Effects of Nitrate of Soda on Citrus Soils. By W. P. Kelley; at Citrus Experiment Station. Riverside. Begun November, 1914.

No. 337. Investigations into the Financial Side of Farming as Applied to the Production of Fruit, Field, Cereal and other Crops of a Similar Nature. By R. L. Adams, reporting to J. W. Gilmore. Headquarters at Berkeley; to cover State. Begun February, 1915.

No. 339. Seasonal Activities of Vine Varieties. F. Flossfeder, A. E. Way and W. E. Packard, reporting to F. T. Bioletti. Begun February, 1915.

No. 341. A Study of the Moisture Relations of California Soils, covering the Moisture Equivalent, Hygroscopic Coefficient and related factors. By Alfred Smith and assistants, reporting to Chas. F. Shaw. Laboratory work done in Berkeley; field work in various parts of the state, as necessary. Begun January 1, 1915.

No. 342. A Soil Survey of the Ukiah Area. By E. B. Watson and R. L. Pendleton, reporting to C. F. Shaw. Located in the Upper Russian River Drainage Basin in Mendocino County. Begun May, 1914; completed February, 1915.

No. 343. A Soil Survey of the San Fernando Area. By J. W. Nelson, L. C. Holmes and party, reporting to C. F. Shaw. Located in the San Fernando Valley in Los Angeles County. Begun February, 1914; completed March, 1915.

No. 344. A Soil Survey of the Honey Lake Area. By John E. Guernsey and party, reporting to C. F. Shaw. Located in the Honey Lake Valley in Lassen County. Begun May, 1914; completed June, 1915.

No. 345. A Soil Survey of the Pasadena Area. By E. C. Eckman and C. J. Zinn, reporting to C. F. Shaw. Located in the eastern part of Los Angeles County. Begun March, 1915; completed August, 1915.

No. 346. A Soil Survey of the Riverside Area. By J. W. Nelson and party, reporting to C. F. Shaw. Located in San Bernardino and Riverside counties. Begun December, 1914; completed August, 1915.

No. 347. A Soil Survey of the Los Angeles Area. By J. W. Nelson and party, reporting to C. F. Shaw. Located in the western part of Los Angeles County. Begun January, 1915.

No. 349. A Study of the Birth Weights and Rate and Cost of Gain from Birth to Weaning of Lambs from Ewes of Different Ages and Breeds. By Robert Miller, reporting to Gordon H. True, University Farm, Davis.

No. 350. Utility of Winter Spraying in the Control of Vine Mildew. By F. C. H. Flossfeder, reporting to F. T. Bioletti. Begun January, 1915. Project completed.

No. 351. Experiment in the Management of Old Groves. By H. J. Webber, W. P. Kelley, W. M. Mertz and others, reporting to H. J. Webber. Begun January, 1915.

No. 352. A Study of the Fumigation Process with Special Reference to the Chemical Problems Involved. By H. J. Quayle, H. D. Young and A. R. Tylor, reporting to H. J. Quayle. Begun April 13, 1915.

No. 353. Spraying for Insect Pests on Citrus and Olive Trees. By H. J. Quayle, A. R. Tylor, and C. P. Clausen, reporting to H. J. Quayle. At citrus groves of Southern California and Tulare County. Begun May 1, 1914.

No. 354. The Mealy Bugs of Southern California. By C. P. Clausen, reporting to H. J. Quayle. At Riverside. Begun May 1, 1914.

No. 355. A Comparative Study of *Cocous Citricola* Campb. and *Coccus hesperidum,* Linn. By H. J. Quayle. Begun January, 1915.

No. 356. A Study of the Life History and Economics of the Scale and Aphid Feeding coccinellids. By C. P. Clausen, reporting to H. J. Quayle. At Riverside. Begun March 1, 1915.

No. 357. The Dispersion of Scale Insects by Wind. By H. J. Quayle and A. R. Tylor, reporting to H. J. Quayle. At citrus groves in different localities of Southern California. Begun June, 1915.

No. 358. Injection of Cyanide Salts in Citrus Trees for the Control of Scale Insects, and of Blackleaf 40 per cent in Walnut Trees for the control of the Walnut Aphis. By H. J. Quayle and A. R. Tylor, reporting to H. J. Quayle. At Whittier and vicinity. Begun January, 1915. Project completed.

No. 359. The Use of the Fungus Isaria in Controlling the Black Scale. By H. J. Quayle and A. R. Tylor, reporting to H. J. Quayle. At Whittier and vicinity. Begun April 13, 1915.

No. 360. A Study of Cost Accounting for Citrus Orchards with a View to Determining as Far as Possible the Actual Value of Cultural Practices. By W. V. Cruess. Begun September, 1915.

No. 361. Survey of Situation of the Citrus Products and By-Products Industries in Southern California. By R. S. Vaile and C. S. Milliken, reporting to H. J. Webber. Begun September 25, 1914. Project completed.

No. 362. Inheritance of Quantitative Characters in Tobacco. By R. E. Clausen, reporting to E. B. Babcock. Begun May, 1913.

No. 363. Strawberry Breeding. R. E. Clausen, reporting to E. B. Babcock. Begun July, 1914.

No. 364. Minor Breeding Investigations. By E. B. Babcock, R. E. Clausen and others. Begun July, 1913.

No. 365. Study of Forest Distribution and Forest Protection in Northern California. By Woodbridge Metcalf, reporting to Walter Mulford. In Humboldt, Trinity, Shasta, Modoc, Lassen and Plumas counties, on or in the vicinity of the National Forests. Begun May 6, 1915.

No. 366. Study of Logging Methods and Market Conditions in Coast Region and Northern Sierras. By M. B. Pratt, reporting to Walter Mulford. In Humboldt, Trinity, Shasta, Modoc, Lassen and Plumas counties. Begun May, 1915.

No. 367. The Cost of Pork Production when Grain is Fed in Conjunction with Alfalfa Pasture. By J. I. Thompson and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis, California. Begun October, 1915.

No. 368. Walnut Breeding Investigation. By L. D. Batchelor, reporting to H. J. Webber. At Riverside, California. Begun fall, 1915.

No. 369. Walnut Root Stock Investigation. By L. D. Batchelor, reporting to H. J. Webber. At Riverside, California. Begun fall, 1915.

No. 370. Alfalfa and Succulent Feed for Dairy Heifers and Cows. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun July, 1915.

No. 371. Comparison of the Effects of Long and Short Pruning on Varieties which are Commonly Pruned both Ways. By F. C. H. Flossfeder, reporting to F. T. Bioletti. Begun July, 1915.

No. 372. Reduction of the Amount of Fortification of Sweet Wines. By W. V. Cruess, reporting to F. T. Bioletti. Begun July, 1915.

No. 373. Rations for Fattening Lambs. By Robert F. Miller, reporting to Gordon H. True. At University Farm, Davis. Begun fall, 1915.

No. 375. A Study of the Development of Stands of *Sequoia Gigantea.* By Woodbridge Metcalf, reporting to Walter Mulford. At Whitaker Forest, Tulare County. T. 14 S, R. 28 E M. D. Meridian. Begun August 1, 1915.

No. 376. A Study of the Reproduction of *Sequoia Gigantea.* By Woodbridge Metcalf and M. B. Pratt, reporting to Walter Mulford. At Whitaker Forest, Tulare County, T. 14 S, R. 28 E, M. D. Meridian. Begun August 1, 1915. Project closed.

No. 377. A Test of Varieties of Fruit for Imperial Valley. By W. E. Packard, reporting to J. W. Gilmore. At Imperial Valley Experiment Station. Begun fall, 1915.

No. 378. Variety Tests of Onions. By S. S. Rogers. At University Farm, Davis. Begun fall, 1915.

No. 379. Variety Tests of Lettuce. By S. S. Rogers. At University Farm, Davis. Begun fall, 1915.

No. 384. The Training and Pruning of Deciduous Orchard Trees. By A. V. Stubenrauch, W. L. Howard and staff, reporting to A. V. Stubenrauch. At University Farm, Davis. Begun February 1, 1915.

No. 385. Planting Distances for Deciduous Orchard Trees. By A. V. Stubenrauch. At University Farm, Davis.

No. 386. Variety Tests of Garden Peas. By S. S. Rogers. At University Farm, Davis. Begun fall, 1915.

No. 387. A Physiological Study of the Effect of Pruning upon the Growth and Productiveness of Citrus Trees and Other Horticultural Plants Grown Under Irrigation in Arid Regions of Southern California. By H. S. Reed, reporting to H. J. Webber. At Citrus Experiment Station, Riverside. Begun September, 1915.

No. 388. A Study of Ammonification and Nitrification in the Soils of Southern California with Special Reference to the Fertilizer Plats of the Citrus Experiment Station. By W. P. Kelley. At Citrus Experiment Station, Riverside, California. Begun October, 1915.

No. 389. Apricot Pruning. By W. P. Tufts, reporting to A. V. Stubenrauch. At University Farm, Davis, and commercial orchards in representative sections of the State. Begun September 27, 1915.

No. 391. Relative Fruitfulness of Canes Originating on Two-Year-Old Wood ("Fruit-canes") and Canes Originating on Older Wood ("Watersprouts" and "suckers"). By F. C. H. Flossfeder, reporting to F. T. Bioletti. Begun December, 1915.

No. 392. Effects of Summer Pruning on the Quantity and Quality of the Crop and on the Vigor of the Vine. By F. C. H. Flossfeder, reporting to F. T. Bioletti. At University Farm, Davis. Begun December, 1915.

No. 393. Value of Various Roughages for Fattening Sheep. By Robert F. Miller, reporting to Gordon H. True. At University Farm, Davis. Begun fall, 1915.

No. 394. Ground Carob Pods as a Constituent of Grain Mixtures for Skim Milk Calves. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun fall, 1915. Project completed.

No. 395. Best Arrangement and Pruning of Vines in a Muscat Vineyard. By F. Flossfeder, reporting to F. T. Bioletti. At University Farm, Davis. Begun fall, 1915.

No. 399. The Control of Lemon Decay Fungi by Wash Water. By E. E. Thomas, reporting to J. T. Barrett. At packing houses in the vicinity of Whittier; Pathological Laboratory, Whittier. Begun December, 1915.

No. 402. Pecan Culture in California. By R. H. Taylor, reporting to A. V. Stubenrauch. At University Farm, Davis, and orchards in representative districts. Begun January, 1916.

No. 403. The Use of Self-Feeders in Feeding Dairy Cows. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun January, 1916.

No. 405. Spineless Cactus for Milch Cows. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun January, 1916.

No. 406. Tests of Chemical Means and Cultural Means for the Control of Wild Morning Glory (Convolvulus Arvensis). By George P. Gray and Thomas Tavernetti, reporting to H. E. Van Norman. At University Farm, Davis. Begun December 23, 1915.

No. 410. An Investigation to Determine the Effect, if any, of Hog Cholera Immunization on the Breeding Qualities of Swine and the Comparative Number and Vigor of their Progeny. By C. M. Haring. Begun February, 1916.

No. 411. June Drop of Oranges. By J. Eliot Coit. At Berkeley and Bakersfield. Begun June, 1916.

No. 414. Raisins as a Feed for Swine. By J. I. Thompson and E. C. Voorhies, reporting to Gordon H. True, co-operating with F. T. Bioletti. At University Farm, Davis. Begun March, 1916.

No. 415. Walnut Blight: Investigation for Control. By H. S. Fawcett, C. O. Smith and L. D. Batchelor, reporting to J. T. Barrett. At Riverside, Whittier, Anaheim and Montalvo. Begun November 1, 1915.

No. 416. Extraction of Olive Oil by Centrifugal Force. By W. F. Oglesby and W. V. Cruess, reporting to F. T. Bioletti. At Berkeley, San Francisco and elsewhere. Begun March, 1916.

No. 418. Feeding Value of Spineless Cactus for Sheep. By Robert F. Miller, reporting to Gordon H. True. At University Farm, Davis. Begun March, 1916.

No. 419. Continuous Feeding of Grain to Pigs with Pasture when Available Compared with Alfalfa Pasture Alone when Available and Stubble Pasture in Season. By J. I. Thompson and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun March, 1916.

No. 420. Detailed Study of Vegetable Garden Work at the Agnew State Hospital. By J. W. Krafft, reporting to S. S. Rogers. At Agnew, California. Begun April, 1916.

No. 422. An Experiment to Determine the Effect of Smutty Wheat on the Health and Productiveness of a Normal Flock of Fowls. By W. E. Lloyd, reporting to J. E. Dougherty. At University Farm, Davis. Begun April, 1916.

No. 423. Control of the House Fly and Stable Fly upon the University Farm. By Ralph deOng, reporting to H. E. Van Norman and C. W. Woodworth. At University Farm, Davis. Begun February 1, 1916.

No. 428. The Timber Yield of California Forests, and its Relation to Fire Protection. D. T. Mason, reporting to Walter Mulford. In Redwood and Sierra Forest region. Begun April, 1916.

No. 431. Factors Affecting the Cost of Log Making and Skidding. By Donald Bruce, reporting to Walter Mulford. Begun April, 1916.

No. 434. Reconnaissance Soil Survey of the Lower San Joaquin Valley. By J. W. Nelson and L. C. Holmes, assisted by J. E. Guernsey and E. C. Eckman, reporting to Charles F. Shaw. Located in northern portion of San Joaquin Valley. Begun April, 1915. Project completed.

No. 435. Soil Survey of the Healdsburg Area. By E. B. Watson, C. J. Zinn and W. C. Dean, reporting to Charles F. Shaw. Location lower Russian River Valley and tributary drainage in Sonoma County, California. Begun June 1, 1915.

No. 437. Reconnaissance of California Practice in the Irrigation of Deciduous Orchards. By Frank Adams, Ralph D. Robertson and an assistant, reporting to Frank Adams. Throughout California. Begun May, 1916.

No. 442. Irrigation Investigations with Field Crops (Davis). Demonstration of Measuring Devices. By S. H. Beckett, assisted by Roy Wray, reporting to Frank Adams. Irrigation Tract, University Farm, Davis. Begun January 1, 1916.

No. 445. Fixation of Nitrogen by and Nitrification of Legumes. By W. P. Kelley and H. D. Young. At Whittier and Riverside. Begun September, 1915.

NEW PROJECTS OUTLINED

As a matter of record, the new problems which have been outlined during the year but on which no data have as yet been reported, are given below:

No. 374. Investigation of the So-called Tick Fever in Imperial Valley. By W. J. Taylor and W. B. Herms, reporting to J. W. Gilmore. At Imperial Valley and Berkeley. Begun July, 1915.

No. 380. Capri Figs and Caprification in California. By I. J. Condit, reporting to J. Eliot Coit.

No. 381. Variation in Oil Content of Immature and Mature Avocados of the Same Variety. Process of Ripening. M. E. Jaffa. Begun September, 1915.

No. 382. Investigation of the Pickling of Ripe and Green Olives, including a Study of the Oil Content of Immature and Mature Olives. By M. E. Jaffa. Begun September, 1915.

No. 383. Investigation of the Nutritive Value of Alfalfa in California. By M. E. Jaffa. Begun September, 1915.

No. 390. Relation of the Number of Vines per Acre to the Quantity and Quality of the Crop. By F. C. H. Flossfeder, reporting to F. T. Bioletti. At Davis. Begun fall, 1915.

No. 396. The Design and Construction of Dairy Barns. By J. B. Davidson and H. L. Belton, reporting to J. B. Davidson. In various parts of the State. Begun fall, 1915.

No. 397. The Design of Hog Houses. By J. B. Davidson. Begun December, 1915.

No. 398. Plans for Beef Barns. By J. B. Davidson. Begun December, 1915.

No. 400. Power Required for Plowing. (The beginning of a study of the utilization of power in agriculture.) By J. B. Davidson and an assistant. At University Farm, Davis. Begun December, 1915.

No. 401. Drainage and Paving for Feed Lots. Co-operating with the Division of Animal Husbandry. By J. B. Davidson.

No. 404. Equipment for the Storage and Handling of Manure (preliminary study). By J. B. Davidson. At University Farm, Davis. Begun January, 1916.

No. 407. Sudan Grass as a Forage Crop for Sheep. By R. F. Miller and B. A. Madson, reporting to Gordon H. True. At University Farm, Davis. Begun January, 1916.

No. 408. Table Figs in California. By I. J. Condit, reporting to J. Eliot Coit. At Berkeley and field trips to the fig districts. Begun February, 1916.

No. 409. Dried Fig Industry in California. By I. J. Condit, reporting to J. E. Coit. At Berkeley and San Joaquin and Sacramento valleys. Begun February, 1916.

No. 412. A Study of California Butter. (Continuation of Project 340 under same plan as for 1915.) By L. M. Davis, at University Farm, Davis, and San Francisco Butter Markets. Begun February, 1916.

No. 413. A Study of Some Factors Affecting the Texture of Ice Cream. By H. S. Baird, reporting to L. M. Davis. At University Farm. Davis. Begun February, 1916.

No. 417. An Investigation to Determine the Effect of Time of Hatching on the Molting of Fowls, the Monthly Egg Production and Age of Beginning to Lay, During Pullet Year. By J. E. Dougherty. At University Farm, Davis. Begun March, 1916.

No. 421. The Value of Sudan Grass Silage for Dairy Cows. By F. W. Woll, B. A. Madson and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun April, 1916.

No. 424. Sterilization of Soil with Sodium Cyanide to Destroy Insects, Parasite Fungi and Weed Seed. By Ralph deOng, reporting to C. W. Woodworth. At University Farm, Davis. Begun April, 1916.

No. 425. Alfalfa Insects. By Ralph deOng, reporting to C. W. Woodworth. At University Farm, Davis. Begun April, 1916.

No. 426. The Application of Scientific Management to the Lumber Industry. By D. T. Mason, reporting to Walter Mulford. At Redwood and Sierra Forest regions. Begun April, 1916.

No. 427. The Protection of Forests from Fires. By D. T. Mason, reporting to Walter Mulford. Forests throughout California. Begun April, 1916.

No. 429. Forest Management in the Redwood Regions. By D. T. Mason, reporting to Walter Mulford. Begun April, 1916.

No. 430. Factors Affecting the Cost of Log Making and Skidding. By Donald Bruce, reporting to Walter Mulford. Redwood Region and Sierra Pine Region.

No. 432. The Use of Timber on a Farm. By M. B. Pratt and R. L. Adams, reporting to Walter Mulford and John W. Gilmore. At ranches and retail lumber yards in Bay Region and Interior Valleys of California. Begun April, 1916.

No. 433. Reconnaissance Soil Survey of the Middle San Joaquin Valley. By J. W. Nelson and L. C. Holmes with field assistants, reporting to Charles F. Shaw. Location middle portion of San Joaquin Valley, roughly between the San Joaquin River and the north boundary of Kern County. Begun April, 1916.

No. 436. Soil Survey of Anaheim Area. By E. C. Eckman, John E. Guernsey, A. T. Strahorn and L. C. Holmes, reporting to C. F. Shaw. At Orange County, California. Begun January 10, 1916.

No. 438. Vegetable Irrigation at Davis (co-operating with Division of Olericulture). By S. H. Beckett, reporting to Frank Adams, and S. S. Rogers. Location, Blocks 2 and 3, Field 6, Irrigation Investigation Tract, University Farm, Davis. Begun April, 1916.

No. 439. Duty of Water in Rice Irrigation in California (co-operating with California State Water Commission). By Ralph D. Robertson, H. S. Patton, and Charles L. Kaupke, reporting to Frank Adams. On eighteen farms in Sacramento Valley. Begun March, 1916.

No. 440. Irrigation of Vineyards. (Continuation of Informal Co-operation running since 1911.) By S. H. Beckett and F. C. H. Flossfeder, reporting to Frank Adams and F. T. Bioletti. At University Farm, Davis. Begun April, 1916.

No. 441. Irrigation of Orchards and Small Fruits (Davis). Co-operation with Division of Pomology. By S. H. Beckett and W. L. Howard, reporting to Frank Adams and A. V. Stubenrauch. Irrigation Tract, University Farm, Davis. Begun May, 1916.

No. 443. Duty of Water for Alfalfa and Disposition of Irrigation Water in Imperial Valley Alfalfa Fields. By C. E. Tait, F. J. Veihmeyer and W. E. Packard, reporting through Frank Adams and J. W. Gilmore. At Alfalfa Fields near El Centro. Begun spring, 1914.

No. 444. Mutual Irrigation Companies in California. By E. C. Tait, reporting through Frank Adams. Throughout California. Begun 1910.

No. 446. Artificial Reproduction of Redwood (Sequoia sempervirens). By Woodbridge Metcalf, reporting to Walter Mulford. At Forest Nursery, Berkeley. Begun May, 1916.

No. 447. A Study of the Growth and Yield of Various Species of Eucalyptus on Different Sites in California. By Woodbridge Metcalf, reporting to Walter Mulford. At San Luis Obispo, Riverside, San Diego, Tulare and Alameda Counties. Also other counties if plantations or groves are available for study. Begun May, 1916.

No. 448. A Study of Trees Suitable for Windbreak Planting on Various Sites in California. By Woodbridge Metcalf, reporting to Walter Mulford. In Central and Southern California. Portions of Sacramento and San Joaquin valleys, seacoast and semi-desert area. Begun May, 1916.

No. 449. Crop Survey of the Russian River Valley. By C. F. Shaw, C. J. Zinn, and W. C. Dean, reporting to C. F. Shaw. Russian River Drainage Basin in Mendocino and Sonoma Counties. Begun May, 1916.

No. 450. The Preparation of Land for Alfalfa Irrigation in Northern and Central California. By S. H. Beckett and R. D. Robertson, reporting to Frank Adams. Mostly in Sacramento and San Joaquin valleys; to a small extent in the alfalfa sections around Pomona, Ontario and Corona. Begun May, 1916.

No. 451. Pumping for Irrigation. By S. H. Beckett and Milo B. Williams, reporting to Frank Adams. Throughout California. Begun May, 1916.

No. 452. The Value of Alfalfa Silage for Growing Dairy Stock. By F. W. Woll and E. C. Voorhies, reporting to Gordon H. True. At University Farm, Davis. Begun May, 1916.

No. 453. Testing Equipment on Forest Telephone Lines. By Donald Bruce, reporting to Walter Mulford. One of the National Forests to be selected by Forest Service. Begun June 1, 1916.

No. 455. Sunburning and Winter Killing of Walnut Trees. By L. D. Batchelor, H. S. Reed and R. S. Vaile, reporting to L. D. Batchelor. Riverside, San Bernardino and Los Angeles Counties.

No. 456. Abnormal Tastes and Odors in Olive Oil. By W. V. Cruess, reporting to Frederic T. Bioletti. At Berkeley. Begun March, 1916.

STATION ACHIEVEMENTS

As required by law, this station publishes from time to time bulletins and circulars giving the results of its inquiries.*

The list of such bulletins and circulars published during the fiscal year ended June 30, 1916, will be found on pages 27–29.

It is obviously impossible and unnecessary to publish in this annual report in any comprehensive manner the achievements of this station. Even if it could be done, such publication would not adequately represent the most important aspect of the college and station activities, because its most important result is the attitude, human and scientific, which has been brought about in the minds of the people. The most significant result has not been the control of insects by spraying or fumigation, nor the reclamation of alkali land by drainage or otherwise, but it is in bringing the people of the state to a determination to make the best possible use of its resources. It is something that can not be measured in dollars and cents, and no one should attempt to do so.

Nevertheless, since this report has a wide distribution, it may prove useful to state briefly some of the results which have a more or less direct bearing on the agricultural industries of the state.

The Avocado.—During the past year 38 samples of the avocado have been examined by Jaffa, the main object being to determine the oil content of these at different stages of maturity. The teachings of these examinations greatly emphasize the desirability of allowing the fruit to become as mature as possible before marketing. The fat content varied from a maximum of 27 per cent to a minimum of 5 per cent. It must not be inferred that every variety of the avocado will yield, if allowed to mature, 27 per cent of oil, but the variety which showed 27 per cent on maturity showed in the immature state 15 per cent. Another variety showing 22 per cent matured showed 14 per cent immature. Another point to be emphasized in this connection is the necessity of careful selection as to variety if the percentage of oil is to be taken into consideration.

It has been demonstrated by Coit that the Babcock test may be used for the determination of fat in avocadoes with sufficient accuracy for a preliminary comparison of the value of seedlings.

The Olive.—Preliminary examinations by Jaffa of olives, labeled ripe olives, show a great variation in the fat content, much greater than can be ascribed to the difference in varieties or to the loss of oil in the pickling process. Experiments previously conducted have proved that such loss is negligible. The wide range, however, is largely due to the processing and marketing of immature olives in place of ripe olives. The color of the olive can not be regarded as an indication of maturity, as the desired shade can be produced by oxidation during the pickling process without the addition of any artificial color. It is confidently expected that the results of more complete investigations which are now being carried on will emphasize the importance and the value of standardization which would protect and encourage those who pack only fully ripe or mature olives. The food value of the ripe olive is far greater than that of the immature olive, in that the oil content is larger in the former than in the latter, the flavor far superior, and the digestion coefficient presumably higher.

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* The law requires the station to publish an annual report and at least four bulletins each year, which must be sent free to any citizen upon request.

Grape Culture.—The testing of varieties by Bioletti has made it possible to select suitable grapes for nearly every viticultural region of California.

Similar work with phylloxera-resistant stock has made it possible to improve greatly the crop and the quality of grafted vineyards.

The methods of establishing resistant vineyards have been greatly simplified and improved, especially the nursery part of the work.

Methods of pruning vines have been introduced and improved which make possible large increases in the yield of most vineyards while economizing costs of operation and prolonging the useful life of the vineyards.

Investigations of the relation between the ripeness of the grapes and the quantity and quality of the raisins have made it possible to increase the profits of most raisin vineyards and in many cases to double them.

The introduction of cooling methods into wineries and the standardization and simplification of the use of sulfurous acid and pure yeast have resulted in considerable improvement in the general quality of California wines and in the elimination of serious losses.

The manufacture of unfermented grape juice from California grapes, founded on the investigations of Cruess, promises considerable future development.

Lately new methods of jelly making and also new methods for the preservation of fruit and vegetables and the manufacture of fruit vinegars have been devised by Cruess.

Pollination Studies.—Plum and prune pollination investigations have been carried on during the past three years by Hendrickson. Observations in 1915 on 50,000 plum and prune blossoms and on 87,000 during 1916 show definitely that all varieties of the Japanese group of plums (*P. triflora*) are self-sterile, with the possible exception of Climax. The varieties of this group seem to cross-pollinate readily. Of the European varieties of plums (*P. domestica*), Tragedy and Clyman show distinct evidences of self-sterility. French and Sugar prunes seem to be self-sterile to some extent. Robe de Sergeant and Imperial prunes are distinctly self-sterile. Imperial, French, and Sugar prunes seem to cross-pollinate satisfactorily.

An important observation during the season of 1916 has been the noticeable lack of pollinating agencies in some prune orchards. The normal set of French prunes was about 4 per cent as compared with 19 per cent on a tree which was covered with a mosquito net tent under which the bees were confined.

During 1916 observations on almonds by Tufts show that there is a distinct pollination problem with this fruit. Thirteen varieties, including practically all grown on a commercial scale in California, proved to be wholly self-sterile under conditions existing at the University Farm. Of still greater importance is the fact that the Nonpareil and I. X. L., two of the leading varieties, were found to be intersterile as well as self-sterile. Ne Plus Ultra was found to be very satisfactory as an interpollinizer with both I. X. L. and Nonpareil.

Observations during 1916 by Tufts on cherries show that the leading commercial varieties grown in the state, including Napoleon (Royal Ann), Lambert, Bing, Black Tartarian and Black Republican, are self-sterile. There is also distinct evidence of intersterility between several varieties, for example, Bing and Napoleon. The work has not yet gone far enough to determine the best pollinizers for cherries in this state.

Development of Fruit Buds.—Preliminary investigation by Howard and Tufts of fruit bud differentiation and development under California conditions indicate that under interior valley conditions at least fruit bud formation occurs from a month to two months later than in other sections of the United States where studies of this phase of fruit production have been made. This evidence will have a distinct bearing on the problems of summer pruning.

Pecans.—Wide observation on the varieties of pecans planted in California show quite conclusively that under northern and middle coastal conditions the nuts do not ripen before the trees become dormant in the fall. There is evidently a lack of sufficient heat to ripen the nuts. In the interior valleys, notably at Chico and Knights Ferry, many pecans have been found to ripen their crops without difficulty. In the southern coast counties, especially San Diego, in some localities many seedlings mature their crops, but many others fail.

Soil Surveys.—The soil survey work is being carried on in co-operation with the Bureau of Soils of the U. S. Department of Agriculture. About 20,000 square miles have been surveyed on the reconnaissance scale, covering the Sacramento Valley area, the Bay Region area, the San Diego area, and the lower San Joaquin Valley area. Of these the Sacramento Valley area alone is published, the others being in press or in manuscript. On the detailed scale about 5000 square miles have been surveyed, covering the Merced, Honey Lake, Ukiah, Riverside, Pasadena, San Fernando, Anaheim, Los Angeles and Healdsburg areas. Of these the Merced area alone is published.

The soil survey consists of a map and report which give, with detail, a complete inventory of the soils of the area covered. Each soil is shown on the map by a suitable color and is described fully in the report.

Drainage Investigations.—The drainage and alkali work is being carried on in co-operation with the Office of Public Roads and Rural Engineering of the United States Department of Agriculture. An area of approximately 160 acres of badly alkaline land has been drained and the alkali washed out by flooding. Good stands of barley and of oats are now growing on the fields where previously only alkali weed could exist. Drainage studies have been made in many parts of the state and assistance has been given in establishing drainage districts in controlling erosion of lands in flood control.

Irrigation Investigations.—The organization of the experiment station of a division of experimental irrigation was effected only two years ago, but irrigation investigations and experiments have been conducted from the station and to a more or less extent through its co-operation for the past fifteen years by the division of irrigation investigations of the United States Department of Agriculture, until recently in the Office of Experiment Stations, but now in the Office of Public Roads and Rural Engineering. This work has covered a wide field, including studies of California irrigation institutions and practice in both their broader and special phases; special studies and reports relating to specific irrigated sections or valleys; general investigations and reports on the irrigation resources of the entire state, accompanied by large scale irrigation maps of the state and of typical sections, all in colors; experiments at the University Farm at Davis as to the best manner and time of irrigating field crops, notably alfalfa, and of the most desirable quantities of water to apply to them; the installation at Davis for experimental, demonstration and teaching purposes of a field laboratory of standard irrigation measuring devices; special investigations at Davis and elsewhere of evaporation losses from soil and water surfaces and of the specific water requirements of various crops; and extensive field studies on a large number of farms in Sacramento and San Joaquin valleys of both the actual and the reasonable duty of water in irrigations for numerous standard crops. The more important recent field studies of irrigation practice at Davis and in the Sacramento Valley have largely pertained to alfalfa and have developed standards of irrigation that heretofore have not been available. For instance, reports are now in preparation showing that very heavy as well as very gravelly soils must be irrigated at more frequent intervals than has often been usual if the water requirements of the irrigated crops are to be met; that single applications of water to alfalfa exceeding 6 to 8 acre-inches per acre are of advantage only where the soil depth desired to be wetted exceeds, say, 6 to 9 feet; and that from 2.5 to 3 acre-feet per acre per season measured at the point of use is all the irrigation water it is advantageous to apply to this crop in most situations in the northern half of the interior valley, applications in excess of these amounts usually being of no value except where, in rare instances and under proper control, it is deemed desirable to raise the ground water level to provide sub-irrigation. This work has developed certain technical information of much value in understanding the proper duty of water, especially with reference to the heavier soil types of Sacramento Valley.

Utilization of Kelps.—It has been found by Burd and others that kelps may be utilized as an important source of supply for fertilizing purposes, and that many of the objections urged to its use are untenable; that the agricultural availability of the nitrogen is comparatively high, and that the organic matter of kelp is quite different from that usually ascribed to it, and has a very small value. The results obtained in the investigation of kelp have been published in seven scientific papers.

Maturity of Oranges.—A study of the Weather Bureau records in various parts of California by Way and a determination of the maturity of oranges have led him to conclude that the factor which chiefly affects maturity is not soil type, irrigation, fertilization, heat, or light units alone, but the ratio between the total heat units and relative humidity of the atmosphere.

"Drink-an-Orange."—Through an idea originating and developed in the Citrus Laboratory by Coit, 400,000 glass utensils designed to remove the juice from oranges are known to have been distributed by one agency alone. The demand is now far ahead of the supply. The result has been a tremendous stimulus to the "Drink-an-Orange" campaign.

New Fruits.—The bulletin on the Loquat by Condit has increased the demand for budded trees of the new improved varieties, thereby causing a marked improvement in the loquat industry. The study of the varieties of Avocadoes by Condit has shown that different varieties have different climatic requirements, some being well adapted to the hot interior valleys and others worthless under such conditions.

Butter Making.—Davis found that butter kept in cold storage during a three-month storage season showed a shrinkage of .6 per cent.

Moldy growth in butter due to contamination of parchment wrappers can usually be prevented by soaking the wrappers in a strong salt (NaCl) solution for several hours before using.

Mold did not grow upon butter containing 2 per cent or more of salt (NaCl).

A good grade of butter can be made from cream possessing a minimum butter fat standard of 35 per cent and an acidity of .45 per cent from May to November, and .35 per cent from November to May, unless the cream is of bad flavor.

The grading of cream and offering a premium of 1 cent per pound of butter fat was the means of a general improvement in the quality of cream delivered to the University Farm Creamery. Twenty-five per cent of the butter fat received would grade A before grading was started—65 per cent after grading was started.

The grading of cream improved the quality of butter made at the University Farm Creamery, where the cream received was mixed and churned.

The grading of cream improved the quality of fresh butter and also the keeping quality of the butter made.

Cheese Making.—Baird has found that it is more difficult to make a good grade of cheese from milk produced under ordinary conditions during the summer months than during the spring and late winter months, even where uniform methods prevail.

Mold growth on cheese which was held in a poorly ventilated refrigerating room could not be prevented by:

1. First washing the cheese with a corrosive sublimate solution.
2. Washing the cheese, also the walls and shelves, with corrosive sublimate solution.
3. Washing the cheese and walls and shelves with a corrosive sublimate solution and fumigating the room by burning sulphur.
4. Artificial circulation of air by means of a fan, although this had a tendency to check the growth somewhat.

Ice Cream.—Davis reports that there was no uniform relation between the consistency of an ice-cream mix and the per cent of swell where different thickeners were used.

Increasing the consistency of the ice cream in the freezer by rapid freezing reduced the per cent of swell.

Decreasing the amount of sugar in the ice-cream mix below normal increased the per cent of swell, but produced an unfavorable effect upon the finished product from the standpoint of flavor and texture.

Increasing the amount of sugar in the ice cream mix above normal decreased the per cent of swell, and, while it produced a better texture, resulted in ice cream which was too sweet.

The consistency of an ice cream mix can be increased by the use of thickeners to a point where the per cent of swell will be materially decreased.

Available Nitrogen.—At the present time the greatest problem in soil fertility in California soils in general is the maintenance of a properly usable or "available" nitrogen supply. Lipman has shown that the available nitrogen is dependent upon a proper physical condition of the soil and the presence of a sufficient supply of organic matter. Relative to other factors, the soil flora has been shown to be weak in rendering nitrogen available, and hence must be stimulated by the use of proper nitrogen fertilizers and by sulfates, mulching and other means. Climate and irrigation directly and indirectly exert profound influences on the soil micro-organisms. Nitrifying and nitrogen-fixing bacteria are curtailed in activity by arid climates and stimulated by humid climates. The opposite is true of cellulose destroying bacteria, while the ammonifying bacteria are only slightly affected by climate, though usually slightly depressed in arid soils. Irrigation of desert soils increases the bacterial numbers in soils, but later injures the soil by packing, so as to reduce the activity of the bacteria in the end. A laboratory method has been developed for testing the availability of nitrogenous fertilizers in different soils, using bacterial activities as an index.

Quality of Arid Soils.—Striking differences have been shown to exist between arid and humid soils. The first class are in general much deeper, allow of deeper rooting by plants, allow bacterial development to greater depths, and contain more lime, potash and magnesia than the former. On the other hand, the arid soils have been shown to be markedly deficient in total and available nitrogen.

The Nature of Alkali.—The nature of alkali, its composition and variation, and the manner in which it originates has been explained. As a result, methods for the control of "alkali" have been recommended and new ones are being added every year. They have ranged from the use of resistant plants to leaching and underdrainage, and the use of gypsum and sulphuric acid.

Soils of California.—Over 100 typical soil columns of California have been studied by Hilgard, Loughridge and Lipman, and the soil's depth, its mechanical and chemical composition and its bacterial population correlated for every region of the state. As a result a much more definite basis for appraising agricultural values of California soils and for recommending methods for their improvement is established.

Antagonisms between Salts.—It is possible to make use of antagonistic influences between different salts to make alkali salts and salts of the heavy metals innocuous under most conditions. This has a direct application to both plant and bacterial welfare and is of importance particularly in soils of arid regions. Thus one salt, itself toxic, may be made to neutralize the toxic effects of another salt. In further work with salts Lipman has shown the stimulating effects to plant growth in soils of the so-called poisonous metals, like copper, zinc, iron, lead and manganese when used in small quantities.

Tuberculosis in Farm Animals.—The high percentage of tuberculosis in cattle and hogs on certain ranches has been found to be due to the failure of the owners to remove promptly animals which develop visible indications of the disease. Physical examination alone, even when performed by an experienced veterinarian, cannot be depended upon, however, to remove all open cases or spreaders. Dependence on one tuberculin test alone will usually fail to stop the spread of the disease in badly infected herds.

The highest accuracy in the diagnosis of tuberculosis in cattle is obtained by alternating or combining with careful physical examination the various methods of tuberculin testing. In co-operation with owners, a total of 18,796 head of cattle have been tested by this station. Of these 2954 head, or 15.6 per cent, reacted. In herds where the percentage of reactors is small the disease may usually be kept in check by semi-annual testing and removal of reactors. In badly infected herds this method often fails to stop the headway of the disease until so many animals have been changed by repeated tests and additions that practically a new herd has been substituted. In all infected herds efforts should be directed to the protection of the new-born animals, feeding pasteurized milk and raising them in isolation from the older cattle.

Experiments have proved that pasteurization, as prescribed under the new California State Dairy Law, is sufficient to kill tubercle bacilli. Experiments have failed to immunize cattle to tuberculosis.

Poultry Diseases.—As a result of an intensive study of poultry diseases by Beach, losses in certain sections from chicken-pox, roundworm (*Ascaris inflexa*) infestation, coccidiosis, and white diarrhoea have been materially reduced. During the four months ending May 1, 1916, 55,087 doses of chicken-pox vaccine have been distributed at cost.

Hog Cholera.—Hog cholera is as prevalent as ever, but the losses from death have been greatly reduced by vaccination. During the past five years 6,400,392 c.c. of anti-hog cholera serum and virus, sufficient to immunize 160,110 hogs, have been distributed. Extensive investigations concerning the results obtained have been summarized in a circular of advice to farmers on vaccination against hog cholera.

Other Veterinary Discoveries.—Among the more important miscellaneous investigations have been studies, resulting in the discovery that the *B. enteritidis* is an occasional cause of infectious diarrhoea in calves; research, concerning lymphangitis in cattle found to be due to acid alcohol fast organisms; experiments resulting in improved methods for laboratory testing of milk; and a survey of the livestock conditions in the Selby Smoke Zone. Literature concerning these can be obtained from the Division of Veterinary Science.

Lettuce.—Rogers grew about eighty varieties of lettuce at the University Farm, Davis, during the present season and found that the Los Angeles and Iceberg varieties did best under Sacramento Valley conditions.

Vegetable Seeds.—Rogers has found it practicable to produce such vegetable seeds as cabbage, cauliflower, lettuce, onions and tomatoes, and by exercising care in selection has been able materially to increase yields.

Vegetables on Consignment.—The station has not found it satisfactory to ship vegetables on consignment. The most satisfactory method has been to sell the crop outright in a special market.

Pear Scab.—Spraying experiments by R. E. Smith show that the Pear Scab can be almost perfectly controlled by two sprayings with Bordeaux mixture or lime sulphur during the blossoming period, that is, from the time the leaf buds begin to open to that when the trees are in full bloom. Spraying before and after this period, which is often extensively practiced and at much expense, was shown to be very ineffective.

Asparagus Rust.—R. E. Smith demonstrated that dusting the asparagus plants with sulphur before rust develops prevents infection. The proper times and methods for treatment, together with contributory agricultural measures such as destruction of wild asparagus and planting rows in the direction of prevailing winds, were determined, so that control of the disease under California conditions is made commercially practicable.

Peach Blight.—No plant disease was ever more threatening in this state than Peach Blight, the fruit and leaf buds being nearly all killed during winter. The cause of this injury was shown by R. E. Smith to be a fungus which is active in cool, rainy weather. Thorough spraying with Bordeaux mixture in late November, and again just before blossoms open with Bordeaux or lime sulphur solution, has given almost perfect control for this disease, and where lime sulphur solution is used in the spring several other very prevalent fungus and insect troubles are prevented.

Pear Blight.—The cause and behavior of Pear Blight has been understood and a method of treatment worked out before the disease reached California, but the pear industry here had developed without the presence of blight, so that when it came the growers had neither the information nor the skill to carry out measures required for its control. The extensive work upon this disease carried on several years ago by R. E. Smith, in co-operation with other agencies, furnished a demonstration of the best methods of handling the disease to practically every pear grower in central and northern California and brought such methods into general practice.

Brown Rot of Citrus Fruits.—The work of R. E. Smith showed that Brown Rot of citrus fruits is due to a soil-inhabiting fungus which gets on the fruit in wet weather and is distributed particularly in the lemon washers. This fungus, which was entirely unknown before our work, was studied and its manner of development led to the discovery that it could largely be prevented from getting on the fruit by a mulch on the ground or by higher pruning. Several chemicals were also found to kill the fungus when used at strengths which were not injurious to citrus fruits. Control measures were developed from these discoveries and have been thoroughly established in commercial practice.

Curly Leaf of the Sugar Beet.—Curly Leaf of sugar beets, which has caused serious losses of crops in certain seasons, is a disease of very obscure nature, but is known to follow the attack of a certain minute leaf hopper. R. E. Smith's investigations have thrown much light on the nature of this disease: as an example of this kind of work, it has been found that a healthy beet contracts the disease when one with Curly Top is grafted into it, whereas formerly the disease was not known to be caused except through the bite of the leaf hopper. Very careful study of the symptoms has shown that many beets of good size become diseased without being seriously injured commercially, whereas young beets are prevented from developing. Observations of the time of year at which the disease usually appears have made its prevention commercially possible to a very considerable extent by changing the time of planting in various districts so that the crop is grown during cooler portions of the year.

Wood Decay of Orchard Trees.—The enormous damage to orchard trees, which occurs so universally that it has come to be considered almost a normal condition, has been explained by Horne as the result of infection through wounds by certain wood-destroying fungi. Cracks in dead wood form the most favorable place of entrance, and since the decay develops gradually from the bottom of the cracks and not on the surface of the wound, the cause of the trouble is not usually evident to the orchardist. A specific program of preventive treatment has been devised. Fruit growers have been very generally impressed with the possibility and importance of prevention of loss from this source.

Walnut Blight.—Investigations upon this subject, commenced several years ago by R. E. Smith, have gone through a period of complete readjustment of the walnut industry in which the Experiment Station can legitimately claim a major influence. The failure of all known methods for plant-disease control to yield a thoroughly successful means of combatting Walnut Blight compelled the resorting to a search for resistant varieties, and in this search it became necessary to take into consideration not only blight resistance but all qualities of the new varieties. During this period the industry has been completely revolutionized by a change from seedling trees to those of definite varieties, and in this development the station has taken an active and leading part. In many other respects influence has been exerted upon methods of walnut production.

Gummosis of Citrus Trees.—The earlier investigations of R. E. Smith brought out certain new features of the widely occurring and destructive disease of citrus trees known as Gummosis, and developed empirical measures for control which gave satisfactory results in practice. Subsequently the investigations of Fawcett, then employed by the State Commission of Horticulture and working in the University laboratory at Whittier, showed that the principal type of Gummosis is due to the same fungus which causes Brown Rot of citrus fruits. Through this discovery certain important additions to previous control methods were made possible and were established in practice.

Effect of Barley on Milk Flow.—In order to determine whether barley has a tendency to dry up milch cows, as is sometimes claimed, five cows in the University Farm dairy herd have been fed rolled barley as exclusive grain feed for varying periods during the past two years. Woll reports that the production of one cow during the past two lactation periods on barley was considerably increased over that during the first lactation period when mixed grain was fed, while the other cows produced somewhat less milk or butter fat on barley than during corresponding periods when fed mixed grain. The results do not indicate that the feeding of barley tends to dry up milch cows, but they suggest that most cows do not do as well on barley alone as on mixed grain rations. Three of the cows had heavier average body weights when on barley than when fed mixed grain, while the opposite was true in the case of one cow.

Alfalfa as a Sole Feed for Dairy Heifers and Cows.—A study of the effect of exclusive alfalfa feeding on the growth and milk production of dairy heifers and cows was begun in April, 1914, and will be continued for several years in order that the effects of the practice of feeding alfalfa only to dairy stock may be fully understood. Thus far heifers fed alfalfa and mixed rations dropped somewhat heavier calves and produced during their first lactation period a marked increase in milk and butter fat as compared to heifers fed alfalfa only.

The Cost of Producing Goat Milk.—Two young pure-bred Swiss milch goats of the Toggenburg breed, kept at the University Farm, produced during the past year 1553.2 pounds of milk, containing 45.01 pounds fat and 1341.6 pounds milk containing 38.67 pounds fat (length of lactation periods 344 and 345 days, respectively). Voorhies found that the cost of the feed eaten by the goats during the year at ordinary market prices amounted to $12.64 and $10.71, respectively, making the feed cost per gallon of milk 6.8 cents and 6.9 cents for the two goats. This is but slightly lower than the average feed cost of a gallon of milk for the cows in the University dairy herd.

Spineless Cactus for Milch Cows.—A trial with spineless cactus for milch cows was conducted by Woll during the spring of 1916. Four grade Holstein cows were placed on the trial and fed cactus ad libitum, in place of Indian corn silage, which was fed prior to the cactus, the rations of the cows being otherwise unchanged, and consisting of alfalfa hay and mixed grain. Cactus was fed during four-week periods, but the amounts of this feed that the cows could be induced to eat were so small that the nutrients supplied formed only an insignificant part of the rations of the cows, viz., 8.3 pounds, 15.5 pounds, 7.3 pounds, and 5.9 pounds of cactus on the average per day for the four cows during the four weeks of the trial.

The slabs fed had the following composition, according to the chemical analysis made by Jaffa: Water, 92.77 per cent; protein, .52 per cent; fat, .12 per cent; N-free extract, 4.43 per cent; fiber, .92 per cent; ash, 1.24 per cent.

The slabs were fed sliced and mixed with the grain feed, which consisted of barley, beet pulp, bran and cocoanut meal, one part each by weight. The amounts of cactus eaten by the cows during the last weeks of the trial did not materially differ from those eaten during the first week. The only way in which the amount could have been increased would have been to starve the cows into eating the feed, which would have deleteriously affected the milk flow both immediately and during the balance of the lactation period, a result which it was not considered advisable to bring about.

A trial was also conducted with cactus vs. corn silage for fattening lambs. It was found in this trial that the corn silage produced 17 per cent more gain with 10 per cent less feed than the cactus ration. It required about ten days to get the lambs to eat the cactus readily.

Official Tests of Dairy Cows.—The past year has witnessed a considerably larger increase than any previous year in the testing of pure-bred dairy cows for production of milk and butter fat in this state. The number of breeders of dairy cattle for whom these tests have been conducted during 1914 to 1915, and for the year ending May 1, 1916, with the total number of cows of the various breeds tested each year, is shown in the following summary table:

SUMMARIES OF OFFICIAL DAIRY TESTS, 1914–15 AND 1915–16

	No. of breeders		Total No. of cows tested	
	1914–15	1915–16	1914–15	1915–16
Ayrshire	1	1	2	2
Guernsey	5	8	61	99
Holstein	25	44	374	740
Jersey	13	17	130	183
Milking Shorthorn	......	1	......	5
Total,	44[1]	71[2]	567	1029

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[1] 41 different breeders. [2] 68 different breeders.

The number of breeders taking advantage of the system of official testing of dairy cows during the past year increased 66 per cent over that of the year 1914–15, and there was an 81 per cent increase in the total number of cows tested. The corresponding figures for 1914–15 over the preceding year were 24 per cent and 32 per cent, respectively. The large increase in this work furnishes striking evidence of the advancement of the pure-bred dairy industry of the state, and of the increasing appreciation on the part of both breeders and dairy farmers of the importance of production records.

Reference should be made to the following exceptional records of production established for California cows during the past year.

Yearly Records.—Princess of Meadowbrook, 25185, owned by Elliot-Brant Rancho, Owensmouth, 722.24 pounds of butter fat. (State record for production of butter fat by a Guernsey cow.)

Fleurette of Riverside Farm, 36286, owned by W. H. Dupee, Santee, 689.96 pounds of butter fat.

Marquis Foxy Belle, 219313, owned by California Polytechnic School, San Luis Obispo, 643.3 pounds of butter fat.

Tilly Alcartra, 123459, owned by A. W. Morris & Sons, Corp., Woodland, 29826.6 pounds of milk and 952.367 pounds of butter fat. (State record for production of butter fat by a Holstein cow and record for a dairy cow of any breed for production of milk in two consecutive years, viz., 60,278 pounds.)

Aaggie Acme of Riverside II, 164467, owned by A. W. Morris & Sons Corp., Woodland, 876.08 pounds of butter fat.

Miss Dutch, 140723, owned by A. W. Morris & Sons Corp., Woodland, 716.60 pounds of butter fat (96.181 pounds in 30 days, 24.042 pounds in 7 days).

Anselogess of Sleepy Hollow, 136382, owned by Miss M. M. Holdridge, Modesto, 717.67 pounds of butter fat.

Thirty-Day Records.—Mosetta Mutual Paul Johanna, 122347, owned by Mrs. Anita M. Baldwin, Santa Anita, 95.476 pounds of butter fat.

Alba Sadie Cornucopia Creetia, 138651, owned by Mrs. Anita M. Baldwin. Santa Anita, 101.338 pounds of butter fat (27.309 pounds in 7 days).

Winnie Korndyke Cornucopia De Kol, 101449, owned by J. S. Gibson Company, Williams, 95.711 pounds of butter fat (22.984 pounds in 7 days).

Seven-Day Records.—Laurameka, 187954, owned by Leland Stanford Jr. University, Vina, 25.838 pounds of butter fat.

Cristeria Overton Mechthilde, 180383, owned by Ben A. Rhoades, Los Angeles, 25.357 pounds of butter fat (89.476 pounds in 30 days).

Gerben Abbekerk Maid, 180387, owned by A. J. Stalder, Riverside, 24.081 pounds of butter fat.

Calf Feeding Experiments.—A series of experiments with dairy calves has been conducted by Woll during the past two years, in which the effect of different feeding stuffs or combinations of feeds has been studied. Two trials were conducted with a view of determining in how far linseed meal is a necessary or desirable component of grain mixtures for skim milk calves fed alfalfa meal. The results of the trial show that it is not necessary to include this feed in the grain mixture, since the calves getting no oil meal made as good gains and were apparently as healthy and thrifty as those receiving oil meal in their grain mixture. Some advantage is, however, gained in feeding oil meal under the conditions considered, in the way of making the rations somewhat more palatable and insuring that all the calves take their feed with a keen appetite throughout the feeding period.

The trials, furthermore, showed that very satisfactory grain mixtures for skim milk calves can be made up of the following California feeds: Milo and barley, dried beet pulp or cocoanut meal and barley, Carob pods and milo. The Carob pods are largely unknown to farmers in this state. The tree furnishing the pods is said to grow well in the central and southern coastal regions. The pods make a very palatable and nutritious feed for calves and other farm animals, including horses, and are highly prized as a stock feed in southern European countries where the tree is commonly grown.

Rations for Fattening Lambs.—One hundred and twenty-five lambs were allowed to graze over a barley stubble field that had yielded 25 sacks per acre and had been harvested with a combined harvester, at the rate of one lamb per acre for a period of five weeks. Miller reports that they made an average gain of 11 lbs. each, making stubble field worth about 75c per acre. These lambs were then put into a feed lot and fed different rations. Barley and alfalfa hay were used as a basal ration and this combination was supplemented with cottonseed meal, cocoanut meal, alfalfa meal and molasses, one lot being fed a commercial feed, alfalfa meal and molasses alone. The cocoanut meal lot made the most economical gains and the cottonseed meal was next. Alfalfa meal and molasses proved to be an expensive feed at $18 per ton.

Silage Crops for Fattening Lambs.—The lambs were separated into four uniform lots which were fed, in addition to alfalfa hay and barley, one of the following silage crops: Indian corn, milo maize or sweet sorghum. Besides one lot was fed alfalfa hay alone. In economy of gain Miller found that the ration containing milo maize silage ranked first and the sorghum silage next. The alfalfa hay lot made only about one-half the gains that the other lots made.

Pork Production with Grain Fed in Conjunction with Alfalfa Pasture.—Self-feeders were used in comparison with hand-feeding. Thompson reports substantial evidence in favor of the self-feeding method. Various supplementary feeds, viz., wheat shorts, cocoanut meal, tankage, and cull beans were used. The cocoanut meal was an economical supplement to barley, but produced severe scouring when fed in considerable amounts. Cooked culled beans produced cheap gains, but a soft, low-dressing product.

Raisins as a Feed for Swine.—Low-grade or cull raisins are occasionally available in sufficient quantities to be of value for stock feeding. A trial was made at the University Farm last season in which the effects of feeding raisins to swine were studied; three lots of eight 5-months old pigs were fed raisins, raisins and barley, or barley alone, respectively, alfalfa meal being fed, in addition, to each lot. Thompson reports that when constituting the entire concentrated part of the ration, raisins produced slow gains and considerable scouring resulted. When barley and raisins were fed in equal parts, the raisins showed nearly the same feeding value as barley.

Experiments with Silage Crops.—The equipment of the University Farm includes five silos: one 150-ton concrete silo, two 90-ton, and one 120-ton wooden stave silo, also one 90-ton re-saw silo. These silos have been filled with the following silage crops during the past year: Indian corn, sweet sorghum, green oats, feterita and first cutting of alfalfa. The silage has been fed to the dairy and beef herd, to sheep and young horses. Under the conditions of the central Sacramento Valley, the silo can readily be filled twice a year, viz., in April or May, with first crop of alfalfa or volunteer grain, either of which makes a valuable succulent feed for summer and early fall feeding; again in October or November with Indian corn, sweet sorghum or varieties of grain sorghums. The first two crops are especially valuable on irrigated land, and the latter for dry land conditions. The preference of stock for silage of the different kinds is reported by Woll to be in general as follows: Indian corn or sweet sorghum stands first; oats, milo, alfalfa and feterita coming next in the order given; feterita being least palatable to the stock.

Plans of Farm Buildings.—In co-operation with other divisions, Davidson has made a study of dairy barn construction in the state and has prepared for distribution, as loans to those interested, detailed plans of a dairy barn especially adapted to California conditions. In a like manner plans have been prepared for movable hog houses, self-feeders, silos, beef barns, and poultry houses. These plans represent successful, efficient and economical construction.

Plans of School Grounds.—Gregg has made a study of school ground design and ornamentation and has prepared for study or exhibition purposes detail and sketch plans, many with planting lists attached, which illustrate the use of the correct principles of design as applied to the economic and aesthetic development of school grounds in California.

Fumigation.—The chief insecticide operation in this state is cyanide fumigation, involving an annual expenditure of $500,000.00. Morse worked out the first practical process and first made public the knowledge of the efficiency of this chemical. The leading advances in the process are due to Woodworth, who determined the importance of the escape of gas through the tent, devised apparatus for measuring tent leakage, originated the plans of tent measurement and the methods of dose calculation.

The Action of Insecticides.—Woodworth has carried on the most detailed series of experiments ever conducted to establish a sound theory of their action. He has found that when a sufficient number of experiments are averaged the results are uniform enough to establish a law of action which is both complicated and unexpected. For toxic doses there are three distinct effects following each other at definite time intervals, depending upon the concentration, and within the first two of these zones the fatality increases with the square of the time, but at a very much more rapid rate in the second zone.

As a result of this study it is now possible, for the first time, to calculate the time of treatment with cyanide fumigation, for instance, corresponding with variations in dose. Thus the doses 7, 8 and 9 oz., will give the same effects in 60, 45 and 32 minutes respectively in tight tents.

Dosage Determinations.—A new apparatus has been made by Woodworth for the determination of dose in fumigation tents. This is a metal disc about the size of a wrist watch, operating on the principle of a circular slide rule, and to be used as a substitute for the large paper dosage tables. This convenient instrument is particularly desirable where accurate determinations must be made rapidly as when fumigating.

The Peachworm.—Clarke discovered that the peachworm in its winter quarters became vulnerable at about the time the buds swell in the spring, and that a very high degree of control could be secured by lime-sulfur spraying at that time. This discovery has resulted in an annual saving of several hundred carloads of peaches in the Newcastle district.

Insecticide Control.—The studies of Woodworth and Colby showing the presence and danger from water soluble arsenic in paris green and other arsenicals resulted in the passage of laws regulating the composition of these materials. This was the starting point of the whole system of insecticide control laws in the United States.

Mosquito Control.—The first campaign conducted in the West for the control of mosquitoes was inaugurated by Woodworth, and other campaigns have been carried on by Quayle and Herms, the latter in the great valley and against the malaria mosquito. All of this work has been notably effectual, showing that the practical elimination of the mosquito is attainable under varying California conditions. This work has resulted in the enactment of the anti-mosquito district law. Districts now organized cover practically the entire west shore of the bay and several interior sections. The public interest thus aroused in this subject has resulted in the present malaria survey by Herms and Freeborn.

The Codling Moth and Neutral Lead Arsenate.—The annual loss of several hundred carloads of apples in the Pajaro Valley is prevented by spraying with neutral arsenate of lead as the result of an investigation conducted by Woodworth. The nightly fogs of that valley rendered it impossible to use the sprays previously employed elsewhere for this insect, on account of serious injury to the tree which resulted through hydrolyzation of other kinds of arsenicals. This new arsenical has been adopted in all parts of the United States for spraying stone fruits and in all cases where arsenical injury is liable to occur.

Insecticide Injury to Foliage.—Extensive and long-continued experimentation by Woodworth has brought out some of the conditions affecting the causes of injury to plants which should be avoided when applying these materials.

For arsenicals it is found to depend on the amount of water soluble arsenic and on weather conditions which tend to increase this amount, and is worse when the plant is neither excessively dry nor especially well supplied with moisture, being directly proportional to the water-absorbing power of the leaves.

For oils it is dependent upon penetration and slow evaporation, therefore a mixed oil is worse than either a light or a heavy oil. Excessive dryness is the condition of the plant in which it is most fatal.

For cyanide the chief condition of injury is the concentration of the gas resulting from the method of generation and from excessive moisture in the tissue as is usually true of growing tips. Injury to fruit is produced in a different way.

Argentine Ant.—Investigations by Woodworth have resulted in the discovery that by using arsenic in syrup at a strength between ¼ and ⅛ per cent, this material will be taken to the nest and result in the death of young and queens. The poison is not effective at this dilution against native species, because they are not persistent enough in carrying the poison home.

The Argentine ant is slowly but inevitably replacing the native species and is by far the most annoying household pest in this class. With this new method of control it is more easily dealt with than any other, and every infested community should employ a competent man to control them, as is done by the City of Berkeley.

Microscope Improvements.—The development of new methods of microscope calculation by Woodworth has greatly simplified microscope designing and has enabled him to produce an instrument now in construction which will greatly aid in the study of living insects and in micrometry. The improvements in calculation consist in the production of a new equation for conjugate foci which is rigorously accurate, and in the perfection of a method of graphic calculation and a system of simple graphs for expressing the optical action of a lens system.

Source of Protein for Fowls.—The results of feeding investigations by Dougherty during the last three years with high protein animal and vegetable feeds would indicate that it makes little difference what kinds of such feeds are fed so long as the ration contains some animal feed, has an approximately correct nutritive ratio, and contains feeds suitable to poultry and properly proportioned so as to be palatable and suitable to the purpose for which it is used.

It was found to be economical to use some animal feed in the ration, but mashes containing as low as 7.7 per cent meatscrap gave as good results as those containing much higher percentages.

Hopper Feeding of Fowls.—Where fowls had free access at all times to hoppers of meatscrap and soybean meal in addition to the basic mash, they ate 10.55 lbs. of meatscrap and 12.7 lbs. of soybean meal per hen per year as compared with 1.8 to 3.6 lbs of soybean meal and meatscrap, respectively, in other pens where the animal and vegetable high-protein feeds were mixed in varying proportions with the mash. Yet the fowls consuming the greater amounts of high-protein feeds laid no better. This would indicate that fowls cannot be trusted to balance their ration but will over-eat of what they like. Such over-eating of expensive feeds, like meatscrap, means, at least, an increase in the cost of the ration.

Fertilization of Citrus Groves.—Webber reports the great importance of supplying organic matter as the most important conclusion to be derived from the experiments in the fertilization of citrus groves that have been under way nine years. Of the usual fertilizer elements (nitrogen, phosphoric acid, and potash), nitrogen is by far the most important element, and is the only one of the usual elements which gives striking and positive results in increasing the yield and growth of the tree. Phosphoric acid and potash have as yet shown little direct effect. Of the two, phosphoric acid seems to be the more necessary on the soils where the experiments are conducted.

Up to the present time the plats receiving stable manure and raw rock phosphate with a leguminous winter cover crop, either of bitter clover (*Melilotus indica*) or purple vetch (*Vicia atropupurea*), have given the best yields and the best grade and size of fruit. The trees in plats thus treated are also in the best condition and have the smallest amount of "mottle leaf."

Green Manuring in Citrus Groves.—The experiments in using winter cover crops as green manures continue to emphasize, reports Webber, the importance of this practice in citrus culture. The use of bitter clover, advocated by this station as the result of these experiments, is becoming very general. A survey made during the spring of 1914 by Vaile and Milliken, brought out the fact that less than 25 per cent of the citrus acreage was growing green manure crops.

The following year this area increased to approximately 30 per cent, while during the winter of 1915 and 1916 evidence showed that at least 50 per cent of the citrus acreage had growing upon it some green manure crop. Bitter clover (*Meliolotus indica*) predominated, with 85 per cent of the area growing cover crop sown to this relatively new plant.

Observations in the field gave added evidence that this legume was more satisfactory than any of the varieties previously grown. The success of this crop has undoubtedly done much to stimulate orchardists to a wider use of green manure crops.

The experimental plats on the station grounds show marked increases in vigor and yield where green manures have been used. This is not only true in the case of annual field crops but also with citrus fruits.

The following table shows the average yield per tree following several soil treatments.

	Eureka lemons	Valencia oranges	Navel oranges
Check (untreated)	85 lbs.	35 lbs.	43 lbs.
Manure	290	345	185
Manure and ground phosphate rock	337	355	182
Manure and ground phosphate rock and legume green manure crop	375	392	320

The Effects of Nitrate of Soda on Soils.—Kelley reports that the continued use of nitrate of soda results, *first,* in a well-defined deterioration in the physical properties of soils. The clay becomes deflocculated, consequently cultivation and irrigation cause the finer particles to settle down into the subsoil, thus interfering with aeration and the movement of water. Where nitrate of soda has been applied annually for a number of years, neither the winter rains nor irrigation waters penetrate to as great a depth as where not applied. *Second,* the use of nitrate of soda causes a rapid loss of the calcium from soils, through double decomposition of the zeolites. *Third,* water extracts from such soils contain an unsually high amount of soluble sodium in proportion to the other bases. *Fourth,* nitrate of soda reacts with calcium carbonate in soils to form small amounts of sodium carbonate (black alkali).

Nitrification.—Kelley finds that the use of manure and leguminous cover crops brings about conditions most favorable to nitrification in southern California. The use of inorganic fertilizers, such as phosphates, potash salts, lime, etc., seems to produce only slight effect on nitrification, whereas the previous application of fertilizers containing organic matter favors nitrification. The use of nitrate of soda probably lowers the nitrifying efficiency. Leguminous cover crops undergo much more rapid nitrification than barley or manure, unless the latter is practically free from straw. Alfalfa hay nitrifies rapidly. The common weed known as Malva (*Malva parviflora*) is highly nitrogenous, sometimes containing more than 3 per cent nitrogen and when plowed under green undergoes remarkably rapid nitrification, almost equal to that of the legumes. In this plant, however, the nitrogen it contains is, so far as known, derived directly from the soil and not from the air as in the case of legumes.

A comparative study on the nitrification of leguminous cover crops indicates that *Melilotus indica,* purple vetch, common vetch and bur clover each contain about the same amounts of nitrogen and likewise undergo rapid nitrification. Canada field peas and Windsor beans, on the other hand, are somewhat inferior.

The results obtained to date strongly emphasize the need of replenishing the supply of organic matter in southern California soils, but non-nitrogenous organic matter, such as oat, rye, or barley straw, seems to be greatly inferior to the legumes, and the former when used should be allowed to become thoroughly rotted before nitrification is needed.

The Movement of Nitrates in Soils.—Nitrification being most active in the cultivated zones of soils, and fertilizers being applied in this zone, nitrates are naturally formed therein to the greatest extent. Clean cultivation prevents the roots of trees from inhabiting this zone. Kelley has found that under the furrow system of irrigation nitrates are not efficiently carried down to the root zone but tend to accumulate in the zone between the furrows. Where cover crops and manure are plowed down, the porosity of the soil permits more uniform diffusion and movement of nitrates into the substrata. In any case, the fertilizing materials and organic matter should be plowed down as deeply as possible so far as uniform distribution of nitrates is concerned.

Green Spot of Lemons.—One of the many spots and blemishes to which lemons and oranges are subject, the so-called ''green spot,'' Fawcett has found to be caused by the action of oil liberated from the rind of the fruit. The effect is greater on fruit in a moist atmosphere and on green or immature, than on fully colored or mature fruit. It is recommended that growers avoid as much as possible picking fruit when wet either with rain or dew, and exercise extreme care in handling damp fruit.

Cottony Rot of Lemons.—Cottony rot of lemons caused by what is probably *Sclerotinia libertiana* has been found by C. O. Smith to attack not only lemon fruit, but lemon twigs, nursery stock and sweet and sour seed-bed stock. Not infrequently in some locations during the winter, considerable damage is done by this fungus attacking blossoms and young setting fruit. Fruit from infected groves should be washed in water containing copper sulfate. Storage boxes containing the fruit should be segregated and frequent inspections practiced.

Internal Decline of Lemons.—Observations and studies by Barrett on internal decline and membraneous stain of lemons indicate very clearly that these two somewhat related apparently non-parasitic diseases reach their maximum of occurence at different times in the year, the former in December, the latter in August. Tree-ripe fruit is more subject to internal decline, while green fruit develops the highest percentage of membraneous stain.

Citrus Root Rot.—Continued studies by Barrett on citrus root rot have shown the so-called dry root rot type to be rather widely distributed. Certain physical conditions, such as poorly aerated, heavy soils and excessive moisture about the crown roots, are considered to be contributory factors. Several species of the genus Fusarium isolated from diseased trees are believed to have causal relation to this type of rot.

Melaxuma of Walnuts.—A comparatively new and in certain localities rather serious disease of walnuts called Melaxuma, has been found by Fawcett to be caused by a fungus, *Dothiorella gregoria.* The disease occurs as black cankers on the trunk, crotches, large limbs, and may at times cause a withering of the branches. The fungus probably spread from the arroyo willow, *Salix lasiolepis,* on which it produces a similar canker. It is recommended that all cankers be cut out, dead and weakened limbs removed, and all wounds painted with Bordeaux paste or other fungicide. Willows near orchards should be kept cut back.

Rust on Apricots.—Investigations by Barrett as to the cause of early serious attacks of rust, *Puccinia pruni-spinosas* Pers. on apricots has led to the conclusion that hold-over foliage on the trees is largely responsible for this condition. Too early pruning in the summer or fall, or early defoliation by rust, tends to cause the development of new foliage growth, much of which may persist on the trees far into the winter and even spring. In infected groves this foliage harbors viable spores of the fungus, making an early spring infection possible. The removal in early winter of all foliage will prevent such attacks.

Distribution of Scale Insects by Wind.—Active young scale insects have been found by Quayle to be carried a considerable distance by the wind. Three or four hundred were captured on Tanglefoot sheets after a couple of days' exposure, at distances of 40 or 50 feet. Some were captured as far as 450 feet from infested trees, though this figure may not represent the extreme spread, as sheets were not placed farther than this distance. Representing more nearly natural conditions in the field, the spread of the scale was carefully observed over a four-acre block of clean trees. An accurate examination of scales on leaves from different trees in this block showed the wind to be an important factor in the spread of scale. These facts indicate in a positive way the necessity for carrying on fumigation solidly over as large areas as possible.

Resistance of Scale Insects to Hydrocyanic Acid Gas.—It has been determined that in certain sections of the citrus belt scales have become more or less resistant to hydrocyanic acid gas. Experiments by Quayle in the Corona district indicate this, where, although greatly increased dosages were used, many scale survived. This was also shown through experiments at Riverside, with scale from Corona and Orange County, fumigated under identical conditions. Similar experiments with black scale in the Charter Oak district apparently indicate a section more resistant than other sections. Increased dosages, with the scale in the proper stage to be killed, did not result satisfactorily.

Selection of Walnut Varieties for Blight Resistance and Heavy Production.—As a preliminary study to determine the most valuable type of walnut for commercial purposes, a seedling Santa Barbara soft shell grove is being studied in detail. This grove is composed of 286 trees. Wide variation exists concerning production of the trees, their susceptibility to blight, their size, their season of leafing out in the spring (foliation), and the season at which the trees become dormant in the fall. In a grove of 286 trees Batchelor found the yields to have varied from 10 to 240 pounds per tree, with a mean yield of 88 pounds. The prevalence of blight varied from 10 per cent of diseased nuts to 90 per cent. The trees blossomed through a period of from four to five weeks. The dormant period varied over a month. Trees which retain their leaves late in the fall are better producers than those which drop their leaves early. Very little relationship occurs between the season of foliation in the spring and the crop production. Very little or no relationship exists between the prevalence of blight and either the season of dormancy or the season of foliation. There is no relationship between the size and vigor of the tree and the prevalence of blight. There is a marked correlation between the size of the tree and its production.

In co-operation with the walnut growers, selections have been made of sixteen promising seedling trees, scattered about the state. These trees are known to be specially heavy producers and more resistant to blight than the average. Scions from such trees have been top-worked on black walnuts at the State School grounds at Whittier, and also propagated as nursery trees.

Increasing the Yield of Potatoes.—Gilmore has demonstrated that thorough and early preparation of the land and superior culture to prevent the loss of moisture and the excessive heating of the soil immediately increased the yield of potatoes. The yields at the University Farm at Davis were 248 bushels per acre, against an average for the state of 145 bushels.

Sudan Grass.—Madson reports that the average yield of Sudan grass hay without irrigation on all the plots from which three cuttings were made during the year was 5.73 tons per acre. This yield compares favorably with alfalfa.

Grain Sorghums.—Trials at various places in the state show that milo, feterita and shallu are three short-season varieties of grain sorghum with wide adaptation to California agriculture. Milo has yielded more than 5000 lbs. of grain per acre at the University Farm at Davis.

SCIENTIFIC AND OTHER PAPERS

Because of their technical character many papers bearing on the investigations of the station are published in the Journal of Agricultural Research, in the University of California Publications, Agricultural Science Series, or other scientific journals. The Journal of Agricultural Research is published by the United States Department of Agriculture and is edited by a committee composed of members representing the United States Department of Agriculture and the agricultural colleges. Many papers of less scientific and more popular character are published in various journals. Below are given a list of scientific and other papers published by the station staff:

Frank Adams

"Progress Report of Co-operative Irrigation Investigations in California, 1912–1914." Cal. State Dept. Eng. Pub. Bull. No. 1, p. 74, illust. 9, map 1.

An account of irrigation investigations and experiments in California, Dec. 1, 1912, to Nov. 30, 1914, under co-operative arrangement between the Office of Experiment Stations of the U. S. Department of Agriculture, the California State Department of Engineering, and the California Agricultural Experiment Station, with a summary of important unpublished data gathered previous to specific date covered by report.

"Irrigation Districts in California, 1887–1915." Cal. State Dept. Eng. Pub. Bull. No. 2, p. 151, illust. 27.

An historical account of operations under the Wright irrigation district act of 1887 with a statement of the causes of the many failures under that act, together with an account of the development of the California irrigation district law from 1887 to 1915, an outline of recent irrigation district development in California and of the status of present districts, and an outline of the California irrigation district act as amended to 1915.

"Orchard Irrigation Methods of California." Dept. of Interior of Canada, Irrigation Branch, Rept. of Proc. Eighth Ann. Conven. of Western Canada Irrigation Assoc., p. 9, illust. 9.

A detailed description of California orchard irrigation practice as illustrated by practice in the Sacramento, the San Joaquin, and the Santa Clara valleys, the Sierra foothills, and the sections around Azusa, Covina, Glendora, Pomona and Riverside.

E. B. Babcock.

"Walnut Mutant Investigations," Proc. Nat. Acad. Sci., Vol. 1, p. 535 (Oct., 1915).

A condensed account of observations and experiments, extending over a period of eight years, which have demonstrated that profound germinal variations take place in walnuts and that these mutations rather than hybridizations are the cause of origin of certain new varieties.

"Peach Breeding." Pac. Rural Press, Vol. 90, No. 24 (Dec. 11, 1915).

A brief account of a breeding project now being conducted by the division of Genetics, University of California.

"The What and Why of Genetics," Univ. Cal. Jour. Agr. Vol. 3, No. 5 (Feb., 1916).

"The Outlook for Teaching and Research in Genetics." Univ. Cal. Jour. Agr., Vol. 3, No. 6 (Mar., 1916).

Two articles dealing with the nature and content of genetics and with the outlook for remunerative employment in this field.

H. S. Baird.

"Factors Affecting Quality of Ice Cream." Ice Cream Trade Jour., Vol. XII, No. 4, p. 28 (April, 1916).

J. T. Barrett.

"Some Observations of Wither-tip in 1914." Proc. 45th California Fruit Growers' Convention, pp. 242–244 (1915).

A review of observations and studies on the wither-tip fungus, and effects produced on citrus, particularly tear-staining of the fruit.

"Apricot Fruit Spots." Univ. Cal. Jour. Agr. (May, 1916).

A brief discussion of apricot rust, *Puccinia Pruni spinosa* Pers.; scab, *Clodosporium beijerinckii Oudem.* and their distribution in southern California in 1914–15.

L. D. Batchelor.

"Problems in Walnut Breeding." Jour. of Heredity, Vol. VII, No. 2, pp. 61–65 (Feb., 1916).

A summary of the characteristics most desired in a commercial variety of walnuts, such as type of tree, productivity, foliage character, disease resistance and nut characters. States a need of several different varieties to be adapted to wide range of soil and climatic conditions in California.

"Variation and Blight Resistance among Walnuts." Bull. Calif. State Hort. Comm., Vol. VI, No. 9, pp. 429–431.

Calls attention to wide range of variation among seedling trees in the walnut groves of California, laying especial emphasis on the importance of selecting varieties for the future which will be characterized by heavy production and freedom from blight.

''Reasonable Returns from Walnuts.'' Pac. Rural Press, Vol. 91, No. 15, p. 444 (April, 1916).

Gives average yields of commercial groves compared with solitary trees. Cautions beginners not to base expected returns on yields of ''door-yard'' trees.

''Some of the Walnut Varieties of the Present and Future.'' Cal. Citrograph (Jan., 1916), pp. 8–9.

Gives a review of the present day commercial varieties and the need of improvement in varieties for the future.

''Irrigation of Peaches.'' Utah Agr. Exp. Sta. Bull. 142, pp. 1–23 (Jan., 1916).

Results of two years' investigation of applying various amounts of water at different seasons and with varying frequency. Effect of the irrigation on tree growth, total crop, quality and color of fruit is noted.

L. D. BATCHELOR and W. E. GOODSPEED.

''The Summer Pruning of a Young Bearing Apple Orchard.'' Utah. Agr. Exp. Sta. Bull. 140, pp. 1–14 (Nov., 1915).

The results of four years' investigation of the effect of pruning apple trees at various seasons, measured by tree growth and crop production.

L. D. BATCHELOR and F. L. WEST.

''Variation in Minimum Temperatures due to the Topography of a Mountain Valley in its Relation to Fruit Growing.'' Utah Agr. Exp. Sta. Bull. 141, pp. 1–27 (Dec., 1915).

Results of two years' work in making a temperature survey of Cache Valley, Utah. The minimum and maximum daily temperatures are recorded for sections of varying elevation adapted to fruit growing.

J. R. BEACH.

''Round Worms in Poultry.'' Petaluma Poultry Journal, Vol. 21, No. 14, p. 1. Also in pamphlet published by Petaluma Chamber of Commerce.

Contains detailed instructions to poultrymen concerning control measures to be used against round worms.

FREDERIC T. BIOLETTI.

''Control of Oidium or Vine Mildew.'' Cal. Cult. (Jan. 13, 1916), and other horticultural trade journals.

Reviews the history of the disease in Europe and California, showing the causes of lack of confidence in the efficacy of sulfur as a remedy. Gives the conditions to be fulfilled to make sulfur effective and states reasons for believing that all other proposed remedies are either ineffective or inferior.

''Phylloxera Resistant Stock for Vines.'' Univ. Cal. Jour. Agr., Vol. 3, No. 6.

Gives a summary of the crops of grafted vines at Davis and Kearney, showing the greater fruitfulness of vines on resistant stocks compared to vines on their own roots, and the superiority in this respect of several stocks over the commonly used Rupestris St. George.

''Renovation of Old Vines.'' Univ. Cal. Jour. Agr., Vol. 3, No. 6.

Shows how the decrepit trunks of old vines can be renewed by means of suckers.

"Viticulture on the Pacific Slope." Report of the International Congress of Viticulture, San Francisco, 1915.

Reviews the causes of the diverse development of grape growing on the Atlantic and on the Pacific slopes. Discusses the general character of grape growing in California and the influence of the various factors of climate. Indicates that the optimum, maximum and minimum temperatures and periodic heat sums determined by European investigators do not apply exactly to California conditions and suggests explanations.

"Relation of the Maturity of the Grape to the Quantity and Quality of the Raisins." Report of the International Congress of Viticulture, San Francisco, 1915.

Experimental data are given showing that not only the quality but the quantity of the raisins increases with advancing ripeness of the grapes. The increase of crop with Muscat grapes may equal over 60 per cent, representing an increase in net profits of over 112 per cent. The commonly accepted drying ratios are shown to be too low.

"Some Avoidable Raisin Losses." The Sun-Maid Herald, Fresno, Oct., 1915.

Discusses variations in the crops of raisin vineyards and their causes.

"Pruning Raisin Grapes." The Sun-Maid Herald, Fresno, Dec., 1915.

Discusses the effects of early and late, light and heavy pruning.

"Grapes on the Pacific Slope." In Cyclopedia of American Horticulture. By L. H. Bailey. Revised edition.

A short account of the varieties of grapes and methods of grape-growing on the Pacific slope.

"Olives." *Ibid.*

A short account of the methods of growing olives and handling the crop, with especial reference to California conditions.

J. ELIOT COIT.

"The Summer Traveling Practice Course as a Means of Teaching Horticulture." Cornell Countrymen, Vol. XIII, No. 1 (Oct., 1915).

A description of the methods used by the writer and a discussion of the results actually accomplished. Paper read before Am. Soc. for Hort. Sci., Berkeley meeting, Aug., 1915.

"Citrus Blast,—A New Disease in California." Univ. Cal. Jour. Agr., Vol. 3, No. 6, illust. 2 (March, 1916).

Popular description of a new citrus disease of importance, first discovered by the writer in California. The name "Citrus Blast" is proposed for the purpose of forestalling confusion.

C. P. CLAUSEN.

"A Comparative Study of a Series of Aphid Feeding Coccinellidae." Jour. Econ. Ent., Vol. 8, No. 5, pp. 487–491 (Oct., 1915).

Data regarding detailed life history and feeding capacity of the more important species of Coccinellidae in California.

R. E. CLAUSEN.

"Ettersburg Strawberries." Jour. of Heredity, Vol. IV, No. 7, p. 324.

An account of the work of Albert F. Etter in the production of improved varieties of strawberries by hybridization of various wild and cultivated species and varieties. Describes methods used in obtaining new varieties and some of the varieties which have been introduced by Mr. Etter.

R. E. **Clausen** with T. H. **Goodspeed.**

''Hereditary Reaction-System Relations. An Extension of Mendelian Concepts.'' Proc. Nat. Acad. Sci., Vol. II, No. 4, p. 240.

A suggested explanation for the behavior of hybrids of *Nicotiana sylvestris* and varieties of *N. tabacum* in heredity, and the significance of this explanation in the interpretation of heredity behavior in species hybridization in general and in ''mutation'' phenomena in *Oenothera.*

W. V. **Cruess.**

''Jelly Investigations.'' (With J. B. McNair.) Jour. Ind. and Eng. Chem. (May, 1916), pp. 417–421.

Reports tests of the suitability of various fruits for jelly making. The effects of temperature, sugar concentration, acid, and pectin on jelly formation are discussed and experiments summarized.

''Making Orange Vinegar.'' Cal. Cult. (July 15, 1915), pp. 51–53.

The control of alcoholic and acetic fermentations is described and a method of making a simple vinegar generator is given.

''Some Results of the Practical Application of Sulfurous Acid and Selected Yeast in the Fermentation of California Wines, 1913 and 1914.'' Proc. Internat. Cong. of Viticulture (July 12–13, 1914), pp. 254–263.

Observations and analyses made on wines from California wineries, 1913 and 1914, demonstrated the superiority of the wines made by the improved methods of fermentation. The results represent practical operating conditions.

''A Simple and Rapid Method for the Estimation of Volatile Acid in Wine.'' (With R. W. Bettoli.) Proc. Internat. Cong. of Viticulture (July 12–13, 1915), pp. 263–267.

Fairly accurate results were obtained by the new method and the length of time necessary to make the determinations was greatly reduced. The apparatus needed was very much simplified.

''The Role of Micro-organisms in Brewing.'' The Brewers' Jour., Vol. XL, No. 1 (Nov. 1, 1915), pp. 2–5.

A review of recent advances made in the study of the relation of micro-organisms to brewing.

''New Citrus Fruit Recipes.'' Orchard and Farm, Jan., 1916, p. 34.

General principles are discussed and directions given for making citrus fruit jellies, marmalades, unfermented juices and vinegars.

''Home Canning: Fruits and Vegetables.'' Pac. Rural Press, July 3, 1915, pp. 4–6; Aug. 14 and Aug. 21, 1916.

Methods of preparing syrups for canning fruits and directions for canning peaches, apricots, pears, blackberries, raspberries, and plums in the home are discussed.

The general principles of fruit juice preservation and specific directions for the home production of grape juice, berry juices, currant, apple, orange, lemon and pomelo juices are given.

''Saving More Oil in the Manufacturing Process.'' The Olive Journal, Vol. I, No. 1 (June, 1916), p. 15.

Amount of oil in press cake from fifteen factories was determined. Notes on the effect of fermentation before pressing on quality of oil. Also other interesting and important factors.

J. B. DAVIDSON.

"Permanent Poultry Houses." (With H. A. Bittenbender.) Iowa State College, Extension Bull. No. 36 (Oct., 1915).

A discussion of the essentials of a good poultry house and general features of construction. Detail plans, bills of materials and estimates of cost are furnished for houses of the half monitor and shed roof type of poultry houses.

"Movable Poultry Houses." (With H. A. Bittenbender.) Iowa State College, Extension Bull. No. 37 (Oct., 1915).

A description of the construction of A-shaped and shed roof poultry houses built on skids or runners, so as to be moved from place to place. Detail plans, bill of materials and estimates of cost are furnished.

"Agriculture and the Engineer." Internat. Eng. Cong., San Francisco, Sept. 20–25, 1915.

A review of the phases of the industry of agriculture in which the engineer can be of service. Attention is called to the large amount of power used in agriculture, exceeding in amount the power used in the manufacturing industries.

"Agricultural Engineering Instruction for Agricultural Students." Trans. Amer. Soc. Agr. Eng., Vol. 9 (Dec., 1915).

A discussion of the need and character of agricultural engineering instruction for agricultural students. It was pointed out that agriculture was changing, first, in that it was becoming more specialized, and second, an increasing use of mechanical equipment was being made.

E. R. DEONG.

"Selecting a Hydrometer." Mo. Bull. Cal. State Comm. Hort., Vol. IV, No. 12 (Dec., 1915).

Attention is called to errors in the readings of different types of hydrometers in the determination of atmospheric moisture.

"Fumigation in Tulare County in 1915." (With H. J. Quayle.) Cal. Citrograph, Vol. 1, No. 5 (Feb., 1916).

Climatic conditions of this region are contrasted with those of southern California, and a comparison made between fumigation and oil sprays in the control of scale insects.

J. E. DOUGHERTY.

"Poultry Keeping in Suburbs." Orchard and Farm, July, 1915.

"Breeding versus Feeding." Orchard and Farm, Aug., 1915.

"Utility Poultry Shows." Orchard and Farm, Nov., 1915.

E. O. ESSIG.

"The Ontario Mealy Bug." Mo. Bull. Cal. State Hort. Comm., Vol. IV, No. 7, p. 343 (July, 1915). 1 illustration.

Attention is called to the economic importance and probable identity of a mealy bug discovered in the citrus orchards at Upland, California.

"The Dried Fruit Beetle." Jour. Econ. Ent., Vol. VIII, No. 4, pp. 396–400, 4 illustrations (Aug., 1915).

A brief description, life history, distribution in California, nature of work and control of this insect.

"Aphididae of California, XI." Pomona Jour. Ent. & Zool., Vol. VII, No. 3, pp. 180–200, 9 illustrations (Sept., 1915).

A continuation of a series of articles under the same heading, containing illustrations and descriptions of two little known aphids and a new species, *Lachnus glehnus.*

"New Records of the Shot-Hole Borer." Mo. Bull. Cal. State Hort. Comm., Vol. IV, No. 9, p. 445 (Sept., 1915).

An economic review of the known distribution and food plants of this destructive orchard pest, together with new records of the same in California.

"The Western 12-spotted Cucumber Beetle." Univ. Cal. Jour. Agr., Vol. 3, No. 1, pp. 12–15, 4 illustrations (Sept., 1915).

A general economic review together with new records of food plants, work and control of this insect which during the summer proved to be quite a severe pest in gardens, nurseries, flower beds and orchards throughout the state.

"The Brown Ctenucha." Pomona Jour. Ent. & Zool., Vol. VII, No. 4, pp. 241–244, 7 illustrations (Dec., 1915).

An article describing all forms of the insect, giving complete life history and distribution as well as figures and a key to the closely related species.

"The Soft Bamboo Scale." Mo. Bull. Cal. State Hort. Comm., Vol. V, No. 2, pp. 72–73, 1 illustration (Feb., 1916).

A short description of the scale and the present known distribution in California.

"The California Peach Borer." Mo. Bull. Cal. State Hort. Comm., Vol. V, No. 3, p. 107 (Mar., 1916).

Correcting the generally published statements regarding the immunity of Myrobalan rootstocks to the attacks of this insect and giving data of its attacks on this stock in California.

"The Distribution of California Insects, I." Mo. Bull. Cal. State Hort. Comm., Vol. V, No. 3, pp. 113–120, 6 illustrations (Mar., 1916).

The first of a series of articles giving the distribution of the more serious insects of economic importance, accompanied by maps of the state. In this article the European elm scale, the purple scale, the citrus white fly, the California peach borer, the pear thrips and the Argentine ant are discussed.

"Journal of Entomology and Zoology." Pomona College Quart. Mag., Vol. IV, No. 3, pp. 42–143, 1 plate (Mar., 1916).

A review of the above-named publication.

H. S. FAWCETT.

"Fighting a Fungus, *Pythiacystis citrophthora,* in the Citrus Orchards." Univ. Cal. Jour. Agr., Vol. 3, No. 8 (May, 1916).

A discussion principally of methods of control now being used against brown rot and lemon gumming, both of which are due to *Pythiacystis citrophthora.*

"Pointers in fungi." Proc. 45th Cal. Fruit Growers' Convention. Supplement to Mo. Bull. Cal. State Hort. Comm., Vol. IV, Nos. 5–6 (1915).

"Melaxuma of the English Walnut." Mo. Bull. Cal. State Hort. Comm., Vol. IV, No. 7, pp. 293–297 (July, 1915).

A description of the disease and of inoculation experiments showing that a species of Dothiorella is the causal agent, and of experiments for control.

F. C. H. **Flossfeder.**

"Phylloxera Resistant Stocks in California." Proc. Internat. Cong. of Viticulture (July 12–13, 1915), pp. 69–76.

Gives a summary of the sugar and acid contents of grapes, diameters of stocks and scions, etc., of grafted vines at Davis.

Howard B. **Frost.**

"The Inheritance of Doubleness in *Matthiola* and *Petunia*, I. The hypotheses." American Naturalist, Vol. 49, No. 10, pp. 623–636 (Oct., 1915). 1 fig., bibliog.

A critical discussion of the factorial hypotheses that have been proposed in explanation of the peculiar inheritance of the character mentioned. A modified hypothesis is proposed, including selective sterility of pollen and differential viability of gametes or embryos.

G. P. **Gray.**

"Herbicide Investigations." Cal. Cult., Vol. XLVI, No. 13, p. 387 (March, 1916); Mo. Bull. Cal. State Hort. Comm., Vol. V, No. 4, pp. 133–139 (April, 1916).

"Physical and Chemical Properties of Cyanide and Acid." School of Fumigation held at Pomona, Cal., Aug. 9–13, 1915. Braun Corporation, Los Angeles, Cal. (1915).

"Sulphur Fungicides." Proc. Internat. Cong. of Viticulture (July 12–13, 1915).

J. W. **Gregg.**

"Landscape Development of School Grounds." The Architect, Vol. X, No. 3, p. 106 (Sept., 1915).

"Landscape Architecture, An Art with a History." The Architect, Vol. X, No. 4, p. 158, and No. 5, p. 206 (Oct. and Nov., 1915).

"The Art of Landscape Design." Home and Grounds, Feb., 1915, p. 44.

"The Landscape Development of School Grounds." The American City, Vol. XIV, No. 1, p. 36 (Jan., 1916).

J. W. **Gregg** with Others.

"Ornamental Shrubs for California." Standard Cyclopedia of Horticulture, 1914 edition, Vol. V, in press.

List of shrubs suitable for California gardens.

"Herbs for California." Standard Cyclopedia of Horticulture, 1914 edition, Vol. III, p. 1474–1476 (May 13, 1915).

C. M. **Haring.**

"The Etiology of Hog Cholera." Jour. Amer. Vet. Med. Assn., Vol. 48 (1915), No. 2, pp. 225–239.

A review of the facts concerning the cause of hog cholera and discussion of data concerning hog cholera virus which have recently appeared in veterinary literature.

"The Control of Hog Cholera." *Ibid.*, pp. 239–247.

A description of the forces available for controlling the spread of hog cholera and suggestions for organizing to prevent the disease.

"Investigation of Livestock Conditions and Losses in the Selby Smoke Zone." (With K. F. Meyer.) U. S. Dept. Interior, Bur. Mines, Bulletin 98 (1915), pp. 474–502.

A report of observations on the condition of livestock in southern Solano County, California, during eight months ending July 18, 1914, with detailed description of several cases of laryngeal paralysis or roaring in horses, probably due to the ingestion of lead.

W. B. HERMS.

"Flies, Their Habits and Control." Cal. State Board of Health, Mo. Bull. (6 figs.), Vol. II, No. 9, pp. 448–464 (Mar., 1916).

"Mental Companionship." Pac. Meth. Advocate, Vol. LXIII, No. 17, pp. 3–4 (Apr., 1916).

"Medical and Veterinary Entomology." The Macmillan Co. (228 figs.), pp. 400 (Nov., 1915).

"Methods of Malaria Control." Trans. of the Commonwealth Club of Cal., Vol. XI, No. 1, pp. 15–21 (Mar., 1916).

"Mosquito Control—the Use of Oil and How to Apply it." Standard Oil Co. Bull. (5 figs.), Vol. III, No. 12, pp. 13–15 (Apr., 1916).

"The Pajaroello Tick (*Ornithodorus coriaceus* Koch) with special reference to life history and biting habits. The Jour. of Parasitology, Vol. II, No. 3, pp. 137–142.

D. R. HOAGLAND.

"The Destructive Distillation of Pacific Coast Kelps." Jour. Ind. and Eng. Chem., Vol. 7, No. 8, p. 673 (Aug., 1915).

Gives the results of a series of small scale distillations of *Macrocystis pyrifera*. There was no indication that the products so derived had any commercial value.

D. R. HOAGLAND with L. L. LIEB.

"The Complex Carbohydrates and Forms of Sulfur in Marine Algae of the Pacific Coast." Jour. Biol. Chem., Vol. XXIII, No. 1 (Nov., 1915).

Describes the isolation and properties of several of the most important compounds present in Pacific Coast kelp. The results are of interest from the standpoint of plant physiology and nutrition.

W. L. HOWARD.

"Profits from Spraying Twenty-five Missouri Orchards in 1914." Mo. Agr. Exp. Sta. Bull. 124.

Bordeaux and lime sulfur were equally efficient in controlling diseases, but the former often burned the fruit or leaves. The cost of spraying with lime sulfur and lead arsenate was 9.29 cents per tree for each application.

"An Experimental Study of the Rest Period in Plants: The Summer Rest of Bulbs and Herbaceous Perennials." Mo. Agr. Exp. Sta. Res. Bull. No. 15.

During their state of rest bulbs could not be forced into growth, but most of the herbaceous perennials could be aroused into growth by proper treatment. Frost, desiccation and ether were the most effective rest period breaking agents.

"An Experimental Study of the Rest Period in Plants: Pot-Grown Woody Plants." Mo. Agr. Exp. Sta. Res. Bull. No. 16.

It was found that practically all woody plants pass through a rest period, and it is believed that all may be aroused into growth by proper treatment, although a few were found to grow with great difficulty. The rest period was believed to be in some way associated with enzyme activity.

"An Experimental Study of the Rest Period in Plants: Seeds." Mo. Agr. Exp. Sta. Res. Bull. No. 17.

The rest period of seeds was studied for a period of seven years, during which time about two hundred species, representing fifty-one orders, were collected. It was found that approximately 76 per cent of the species have a definite rest period.

"An Experimental Study of the Rest Period in Plants: Physiological Changes Accompanying Breaking of the Rest Period." Mo. Agr. Exp. Sta. Res. Bull. No. 21.

It was concluded that the rest period begins to set in on woody plants in summer on account of the inhibition of enzymes by the accumulation of the products of their work.

"Some Observations on the Fruit Growing Industry of California." Twelfth Ann. Rept. of the Soc. for Hort. Sci., 1915.

Some of the hardest possible problems, those of marketing fruit two thousand miles or more away, have been solved successfuly, so that it appears certain that orchard difficulties of all kinds will be overcome.

"The Need for More Horticultural Research." Twelfth Ann. Rept. of the Soc. for Hort. Sci., 1915.

The need is emphasized in order that horticultural teachers may be able to give their students facts rather than mere opinions.

"About Pruning." Univ. Cal. Jour. Agr., March, 1916.

While certain pruning practices are followed by fruit growers in California, very little is yet known about the fundamentals of the operation. Extensive experiments now under way ought to throw much light on the subject within a year.

Thomas Forsyth Hunt.

"The Relation of a Permanent Agriculture to the Social Welfare." Senate Document 64th Congress, No. 239, pp. 1–8.

A discussion of the motive for a national Land Credit System.

"An Account of the Methods of Work of the Agricultural Institutions in California." Proc. 29th Ann. Conv. A. A. A. C. and E. S., pp. 83–90; also in U. C. Chronicle, Vol. XVIII, No. 1, pp. 25–39.

"The Preparation Required for Research Work in Agriculture." Proc. 29th Ann. Conv. A. A. A. C. and E. S., pp. 159–161.

"Agricultural Achievements of the Century," The Ohio Farmer, Vol. 137, No. 3, p. 63.

"To the Incoming Agricultural Man." Univ. Cal. Jour. Agr., Vol. 3, p. 5.

"Reaching the Young Man who does not Graduate from the High School." Proc. Ann. Meet. Calif. High School Teachers' Assn. (1915), pp. 48–50.

Katherine D. Jones.

"Herbs for California." (With others.) Stand. Cyclo. Hort., p. 1474–1486 (May, 1915).

W. P. Kelley.

"The Biochemical Decomposition of Nitrogenous Substances in Soils." Hawaii Station Bulletin 29 (Aug., 1915).

The results obtained indicate that certain groups of nitrogen compounds contained in these substances undergo ammonification more rapidly than others. In most cases it was found that the diamino nitrogen disappeared and probably passed into ammonia more rapidly than that occurring in other groups.

"The Soils of the Hawaiian Islands." U. S. D. A. Hawaii Station Bulletin 40 (Aug., 1915). (Joint paper with Wm. McGeorge and Miss Thompson.)

A brief summary of the six years' investigations conducted with the soils of the Hawaiian Islands, dealing with the origin, chemical, physical and biological properties of the soils and the management of the same.

"Some Suggestions on Methods for the Study of Nitrification." Science (n.s.) XLIII, No. 1097, pp. 30–33 (Jan., 1916).

The investigations indicate that radically different results may be obtained where small amounts of blood, bone meal, etc., are used, such as compare with practical applications, as contrasted with those obtained where 1 per cent, for instance, of dried blood is used.

C. B. Lipman.

"Plant Ecology and the New Soil Fertility." Memoirs N. Y. Bot. Gard., 1915–16.

Points out possibilities for co-operation between soil students and plant physiologists in the use of new methods now developing in soil science.

"A Detailed Study of the Effects of Climate on Important Properties of Soil." Soil Science, Vol. 1, No. 1, p. 1 (1916).

Reports results of an intensive study of soils from the tri-soil exchange plots at Maryland, Kansas, and California.

"A Preliminary Statement on the Present Status of the Humus Nitrogen Problem in Arid Soils." Soil Science, Vol. 1, No. 3, p. 285 (1916).

Points out the error in the conception until now in vogue that humus of arid regions is richer in nitrogen than that of humid regions.

"Preliminary Experiments on Some Effects of Leaching on the Soil Flora." (With L. W. Fowler.) Soil Science, Vol. 1, No. 3, p. 291 (1916).

Shows that leaching salts from soil in laboratory scarcely affects ammonifiers, but almost entirely inhibits nitrification and nitrogen fixation.

"A Critique of the Hypothesis of the Lime-Magnesia Ratio." The Plant World, Vol. 19, Nos. 4 and 5 (April and May, 1916), p. 83.

A critical review of the present status of Loew's lime-magnesia ratio hypothesis.

"Tillage: Its Rationale and Its Dangers." The Agricultural Student, Ohio State University and Proc. Farmers' Inst. Workers of Amer., Aug., 1916.

A critical review of our conceptions with regard to tillage, and discussion of new experiments bearing on the validity of those conceptions.

R. H. Loughridge.

"The Life Work of Eugene Woldemar Hilgard." Univ. Cal. Chronicle, April, 1916; Science, March 31, 1916; Proc. Soc. Prom. Agr. Science, 1916.

D. T. MASON.

''The Utilization and Management of Lodgepole Pine in the Rocky Mountains.'' Bull. No. 234, U. S. Dept. Agr., 54 pages (July 12, 1915).

This is the second bulletin dealing with lodgepole pine. It completes the discussion of the subject, giving data on the available supply, the present rate of utilization, methods of utilization, and methods of silviculture management.

''Regional Forest Plans.'' Proc. Soc. Amer. Foresters, Vol. X, No. 4, p. 371, 5 pp. (Oct., 1915).

Discusses the preparation of plans for forest regions in advance of the preparation of plans for national forests so that plans for individual forests may be based on facts and policies holding good for the entire region.

''Brush Disposal in Lodgepole Pine Cuttings.'' Proc. Soc. Amer. Foresters, Vol. X, No. 4, p. 399, 6 pp. (Oct., 1915).

As a result of the study of fire losses in the past this paper advocates the disposal of brush through regulated grazing under certain conditions, rather than by piling and burning, a much more costly process followed in the past.

''The American Forester: What the Society has Done and Can Do for Him.'' Proc. Soc. Amer. Foresters, Vol. XI, No. 1, p. 59, 7 pp. (Jan., 1916).

Paper presented before the San Francisco meeting of the Society of American Foresters held at the P. P. I. E. in October, 1915.

Discusses the organization and changes needed to secure greatest effectiveness in the Society of American Foresters.

E. MEAD.

''State Aid in Land Settlement.'' Published by State Rural Credits Commission, 1915.

Describes conditions governing settlement in California and the systems of state aid in other countries, especially Australia.

''Rural Credit System Needed in Western Development.'' Univ. Cal. Chronicle, Vol. XVIII, No. 1.

Describes changing conditions in the western half of the United States arising out of increased prices of land and of water; the need of lower rates of interest, longer time for loans, and of expert advice and direction in colonization.

M. R. MILLER.

''Tobacco and its Use as an Insecticide.'' Pac. Pharmacist, Vol. 9, No. 11, pp. 295–300 (March, 1916).

R. F. MILLER.

''Feeding Fat Stock at the University Farm.'' Orchard and Farm, Vol. 28, (Jan., 1916), p. 24.

''The Sheep Market.'' Univ. Cal. Jour. Agr., Vol. 3, No. 7 (April, 1916), pp. 271–72.

WALTER MULFORD.

''Logging Engineering at the University of California.'' The Timberman, Vol. XVII, No. 2, pp. 32, 33.

''The University of California.'' Yale Forest School News, Vol. IV, No. 1 (Jan. 1, 1916), p. 4.

W. F. OGLESBY.

"The Selection, Planting, and Care of an Olive Orchard in California." Mo. Bull. State Hort. Comm., Vol. IV, No. 9, pp. 414–425.

A statement of the requirements of tree and fruit as to climate, soil, etc. Gives methods of preparing and cultivating the soil, selection, planting and care of trees, and a list and description of the more common varieties grown here.

"Olives in California, 1769–1916." The Olive Journal, San Francisco (May, 1916).

An historical review; also short statement of present outlook. A general survey of the growth of the industry from the time of the Franciscan Fathers' first plantings at San Diego to the present.

H. J. QUAYLE.

"Grape Insects in California." Rept. Internat. Cong. Viticulture, pp. 174–181. July, 1915 (San Francisco).

An account of the more important grape insect pests in California.

H. J. QUAYLE with A. R. TYLOR.

"The Use of the Fungus Isaria in the Control of the Black Scale." Mo. Bull. Cal. State Hort. Comm., Vol. IV, No. 7, pp. 333–339 (July, 1915).

An account of experiments in the artificial dissemination of the fungus in the field, together with experiments carried on in moist chambers in laboratory and field. Also an account of observations made on this fungus and its effect on the black scale, from 1908 to the present time.

"Scale Control on Citrus Trees." Cal. Citrograph, April, 1916, Vol. 1, No. 7, pp. 8, 9.

A discussion of methods of control of scale insects most applicable at the present time. An account of experiments carried on in the dispersion of young scales by wind and its relation to block fumigation.

"Fumigation in Tulare County in 1915." Cal. Citrograph, Vol. 1, No. 5, pp. 14–15 (Feb., 1916).

An account of work carried on in fumigation under Tulare County conditions during the season of 1915.

"Are Scales Becoming Resistant to Fumigation?" Univ. Cal. Jour. Agr., May, 1916.

A discussion of fumigation experiments carried on with fruit from different sections, showing apparently that the red scale in the Corona district is more resistant than in Orange County.

H. J. QUAYLE with E. R. DEONG.

"Fumigation in Tulare County in 1915." Cal. Citrograph, Vol. 1, No. 5 (Feb., 1916).

Climatic conditions of this region are contrasted with those of southern California, and a comparison made between fumigation and oil sprays in the control of scale insects.

H. S. REED.

"The Cedar Rust Disease of Apples Caused by *Gymnosporagium juniperi-virginianae*, Schw." Va. Agr. Exp. Sta. Tech. Bull. 9, pp. 1–106. (With C. H. Crabill.)

An account of the etiology of this fungous disease and the physiological reactions of its host plants. Discusses the problems of control by spraying and other means.

''Notes on Plant Diseases observed in Virginia in 1913 and 1914.'' Va. Agr. Exp. Sta. Rept., 1913–14, pp. 37–58. (With C. H. Crabill.)

A report on new or little known diseases of plants of Virginia.

''Nitrogen Fixation and Nitrification in Various Soil Types.'' Va. Agr. Exp. Sta. Rept., 1913–14, pp. 59–80. (With Bruce Williams.)

Studies of the nitrogen content of so-called virgin and cultivated soils and the action of bacteria in them.

''The Effect of Some Organic Soil Constituents upon Nitrogen Fixation by Azotabacter.'' Va. Agr. Exp. Sta. Rept., 1913–14, pp. 81–95. (With Bruce Williams.)

A study of the action of various organic compounds upon the nitrogen fixation power of Azotobacter in pure cultures.

''Some Effects of Temperature upon the Growth and Activity of Bacteria in Milk.'' Va. Agr. Exp. Sta. Tech. Bull. (in press). (With R. R. Reynolds.)

Shows the effects upon the number of organisms, amounts of acid produced, the ability to reduce methylene blue, character of curd formed, and other results.

C. L. ROADHOUSE.

''The Supervision of the Certified Dairies in the San Francisco Bay Region.'' Proc. Amer. Assn. of Med. Milk Commissions, Ninth Annual Session, San Francisco, June, 1915.

Reports the procedure followed by the San Francisco County and Alameda County Medical Milk Commissions in the supervision of certified milk.

''The Bacillus Enteritidis as the Cause of Infectious Diarrhea in Calves.'' Jour. Amer. Vet. Med. Assn., Vol. XLIX (n. s.), Vol. 2, No. 1, p. 17. (With J. Traum and K. F. Meyer.)

Reports an outbreak of infectious diarrhea in calves which made its appearance in the course of a feeding experiment and in which *B. enteriditis* was proved to be the causative agent.

''The Success and Failure of the Tuberculin Test in Certified Dairies.'' Jour. Amer. Vet. Med. Assn., Vol. XLVIII (n.s.), Vol. 1, No. 4, p. 420.

Discusses the use of the subcutaneous tuberculin test alone and the use of this test alternated semi-annually with the intradermal test; together with the history of the status of tuberculosis in herds where such procedures have been followed.

''The Milk Situation on the Pacific Coast.'' Mo. Rept. Cal. State Board of Health (Jan., 1916), Vol. II, No. 7.

Discusses the general improvement which there has been in the quality of milk produced along the Pacific Coast during the past few years, the benefit from the cooler summer weather, and the influence of inspecting departments and public-spirited organizations in improving city milk supplies.

L. T. SHARP.

''Salts, Soil Colloids and Soils.'' Proc. Nat. Acad. Sci., Vol. 1, p. 563 (Dec., 1915).

A preliminary statement on elaborate experiments dealing with new studies of the relations of soil colloids and salts.

"Fundamental Interrelationships between Certain Soluble Salts and Soil Colloids." Univ. Cal. Publ. Agr. Sci., Vol. 1, No. 10, p. 291 (April, 1916).

A detailed report supplementary to the preceding. Includes some new and striking results on deflocculation and its possible causes and some new light on the alkali problem.

C. O. SMITH.

"Preliminary Studies on Resistance to Artificial Inoculations with *Bacterium tumefaciens.*" Phytopathology, Vol. 6, No. 2 (April, 1916).

Tables are given showing relative resistance of thirty-six species and varieties of the genus Prunus. Discussion of the adaptability of these as a stock for the various stone fruits is given.

"Cottony Rot of Lemons in California." Phytopathology, Vol. 6, No. 3 (June, 1916).

This is a more condensed and technical paper than that on the same subject published in Cal. Sta. Bull. No. 265.

"The Control of Crown Gall." Pac. Rural Press, Vol. 91, No. 15, pp. 441 and 458 (April 8, 1916), and Cal. Cult., Vol. 46, No. 14, pp. 424–425 (April 6, 1916).

These articles consider the practical control of this trouble under resistant stocks, the use of soil free from infection, careful inspection, tree surgery, and use of germicides on roots before planting.

"Crown Gall or Plant Cancer." Mo. Bull. Cal. State Comm. Hort., Vol. 5, No. 6 (June, 1916).

A general description of the disease, hosts attacked, stocks showing resistance, and other suitable measures to employ in combating the trouble.

SMITH, E. H.

"Pythiacystis infection of deciduous nursery stock." Phytopathology, Vol. V, No. 6 (Nov., 1915).

Describing quite a widespread killing of young trees, due to a fungus identical or closely allied to that causing brown rot and gummosis of citrus trees.

R. E. SMITH.

"Connection of a Bacterial Organism with Curly Leaf of the Sugar Beet." Phytopathology, Vol. 5, No. 6, pp. 335–341 (Nov., 1915).

An account of further investigations concerning the nature of the Curly Leaf disease of sugar beets, and the relation of the insect *Eutettix tenella* thereto.

R. T. STEVENS.

"Ornamental Shrubs for Southern California." California Garden, Vol. VII, No. 6, pp. 7–9 (Dec., 1915).

Lists of shrubs adapted to southern California, arranged under various sub-heads according to character and color of their flowers.

"The Garden Use of Roses near San Francisco Bay." The American Rose Annual, Edition of 1916, pp. 91–94.

Criticisms on the use of the rose in California gardens, with suggestions regarding their correct landscape value on the Pacific Coast. Suggestions are also offered relating to the culture of the rose in this state.

"Ornamental Shrubs and Their Landscape Value." The Architect, Vol. X, No. 6, pp. 254–256 (Dec., 1915).

An endeavor to exemplify the more scientific use of shrubby plant material in California gardens.

"Herbs for California." Stand. Cycl. Hort., Edition of 1914, Vol. III, pp. 1474–1476 (May 13, 1915). (With others.)

List of herbaceous plants adapted to California, arranged under various sub-heads, according to their garden employment. Each sub-head is elaborated by a short descriptive text.

"Ornamental Shrubs for California." Stand. Cycl. Hort., Edition of 1914, Vol. V, in press. (With others.)

List of shrubs suitable for California gardens.

A. V. STUBENRAUCH.

"Relation of Handling Methods to the Keeping Qualities of Citrus Fruits." Riverside Enterprise, May, 1915.

A popular discussion of the relationship of handling methods to the behavior of citrus fruits in transit, in storage and on arrival in market.

"Relation of the Transportation and Storage of Fruits and Vegetables to the Conservation of these Food Supplies." Jour. of Sociological Med., Vol. XVI, No. 6 (Dec., 1915).

Calls attention to the importance of transportation and storage in supplying large centers of population with wholesome fruits and vegetables. The discussion also attempts to correct some of the misconceptions regarding cold-stored food supplies.

"Important Factors Governing the Successful Transportation of Table Grapes." Proc. Internat. Viticultural Cong., June, 1915.

The definite relationship between methods of handling, packing and preparing table grapes for shipment and their behavior while in transit, and after arrival in market, has been established by these investigations.

"Some Lessons from the California Nut Industry." Proc. Nat. Nut Growers' Assn., October, 1915. (With R. H. Taylor.)

A description of the California nut industry, written especially to call attention to some of the factors underlying the success of the industry in this state. Special attention is given to the organization of co-operative associations for marketing crops.

R. H. TAYLOR.

"Almond and Walnut Production." Published by Y. M. C. A., San Francisco, California, April 4, 1916.

A review of the important problems of production and marketing as they might affect the city man's chances in this line of horticulture.

"The California Almond." Univ. Cal. Jour. Agr., Vol. III, No. 6, (March, 1916), pp. 229–231.

A general review of the almond situation in California as regards production, methods of harvesting and of marketing.

"Present Status of the Nut Industry in California." Proc. Soc. Hort. Sci. (1915), pp. 31–39.

A general review of the culture and production of the various nuts grown in California, together with a brief consideration of future prospects.

"The Status of California Pomology: Almonds." Proc. Amer. Pom. Soc. (1915).

J. I. THOMPSON.

"Berkshires Average 148 Dollars at San Francisco." Breeders' Gaz., Nov. 18, 1915.

"California and Pork Production," The Swine World, Sept. 1, 1915.

"Durocs at the Northwest Livestock Show at Lewiston, Idaho." Duroc Bulletin, Jan. 15, 1916.

"The Free Choice System." Univ. Cal. Jour. Agr., April, 1916.

A statement of the results to be expected when self-feeders are employed for feeding growing hogs, especially the advantages to be expected when compared with hand-feeding.

"Hogs at San Francisco." Breeders' Gaz., Nov. 25, 1915.

"Hog Supply and Market Conditions in California." Univ. Cal. Jour. Agr., May, 1916.

"Horse Show at P. P. I. E." Live Stock and Dairy Jour., Nov., 1915.

"Types of Horses." Live Stock and Dairy Jour., Oct., 1915.

"The Value of Public Sales." Univ. Cal. Jour. Agr., April, 1916.

J. TRAUM.

"What Can be Added to Our Laboratory Methods and Standards to Improve Certified Milk." Amer. Jour. of Vet. Med., Vol. X, No. 10, p. 717.

Gives methods now in vogue in making examinations of certified milk; discusses with relation to certified milk production, advisability of adopting clarification, direct microscopic examination of milk for determination of bacteria content, microscopic test for pasteurized milk with new suggestions, etc.

"Lymphangitis in Cattle due to an Acid Alcohol Fast Organism." Jour. Amer. Vet. Med. Assn., Vol. XLIX (n.s.), Vol. 2, No. 2, p. 254.

Report of cases of lymphangitis in cattle in which an organism indistinguishable from tubercle bacillus morphologically and tinctorially has been found. Gives clinical manifestations, results of media and animal inoculations, etc.

GORDON H. TRUE.

"The Hereford Herd at the University of California." Prosperity Edition Amer. Hereford Jour., to appear in June.

"Pure Bred Live Stock in California." Proc. Cal. State Vet. Med. Assn., 1915.

"Raising Horses for Farm and Market." Pac. Rural Press, Jan. 29, 1916.

E. P. VAN DUZEE.

"A Preliminary Review of the West Coast *Cicadidae*. Jour. N. Y. Ent. Soc., Vol. XXIII, No. 1 (Mar., 1915).

"Priority in Family Names and Related Matters." Read before the Berkeley meeting of the Entomological Society of America, August 5, 1915.

"Monograph of the North American Species of *Orthotylus* (Hemiptera). Proc. Cal. Acad. Sci., Fourth Series, Vol. VI, No. 5, pp. 87–128 (May 8, 1916).

"New Genera and Species of North American *Hemiptera*." Pomona Jour. Ent. and Zool., Vol. III, No. 2 (June, 1915).

"Review of the Genus *Macrotylus*. Fieb. (Hemiptera), Vol. VIII, No. 1 (Mar., 1916).

"Synoptical Keys to the Genera of the North American *Miridae*." Univ. Cal. Publ. Ent., Vol. 1, No. 3, pp. 199–216 (Feb. 2, 1916).

"New or Little Known Genera and Species of *Orthotylini* (Hemiptera)." Univ. Cal. Publ. Ent., Vol. 1, No. 4, pp. 217–227 (March 3, 1916).

"The North American Species of *Draeculacephala* (Honoptera)."

E. C. VOORHIES.

"The Milch Goat in California." Univ. Cal. Jour. Agr., May, 1916, 4 pp.

H. J. WEBBER.

"The Citrus Experiment Station and Graduate School of Tropical Agriculture." Univ. Cal. Jour. Agr., Vol. 3, No. 2, p. 49.

"The Results of Fertilization Experiments at the Citrus Station." Cal. Citrograph, Vol. I, No. 2, p. 5.

"Station Work for the Avocado." Rept. Semi-Annual meeting of the Cal. Avocado Assn., Los Angeles, Oct., 1915, p. 69.

"The New Buildings of the Citrus Experiment Station and Graduate School of Tropical Agriculture." Univ. Cal. Jour. Agr., Vol. 3, No. 9 (May, 1916).

E. J. WICKSON

"Second Thousand Answered Questions in California Agriculture." (A Sequel to "One Thousand Questions in California Agriculture Answered.") 12 mo., 256 pp. Pac. Rural Press, San Francisco, 1916.

This book is made up of selected answers to questions asked by farmers. Divided into nine parts: Fruit Growing, Vegetable Growing, Grain and Forage Crops, Soils, Fertilizers and Irrigation, Live Stock and Dairy, Feeding Animals, Diseases of Animals, Poultry Keeping, Pests and Diseases of Plants.

"Life and Work of E. W. Hilgard." Univ. Cal. Chronicle, April, 1916.

An address at the University Memorial Exercises.

"Historical and Analytical Sketches of California Agriculture, viz:
Position and Promise of the Fruit Industry. Pac. Rural Press, Oct. 23, 1915.
Why California for Live Stock? *Loc. cit.*, Oct. 30, 1915.
Peter Prunegrower's Problem. *Loc. cit.*, Dec. 11, 1915.
What California Should do for Bread. *Loc. cit.*, Jan. 22, 1916.
Why Raisin Men Should Keep the Faith. *Loc. cit.*, Feb. 19, 1916.
California Should Get more from the Soil. *Loc. cit.*, Mar. 25, 1916.
The Uniqueness of California Hay. *Loc. cit.*, Apr. 22, 1916.
California's Duty to the Peach. *Loc. cit.*, May 27, 1916.
What Sheep Did for California. *Loc. cit.*, June 10, 1916."

"Suburban Life in California." California's Magazine, June, 1916.

F. W. WOLL.

"Wisconsin Dairy Cow Competition." Univ. Cal. Jour. Agr., April, 1916, 3 pp.

"Some California Feeding Problems." Trans. Soc. Prom. Agr. Sci., 1915, pp. 28–40.

A resume of research work in animal nutrition at the California Agricultural Experiment Station during 1913–1915.

"Testing Milk and Its Products." 23d edition, 297 pp. Madison, Wis., 1916. (Jointly with E. H. Farrington.)

C. W. WOODWORTH.

''Quantitative Entomology.'' Ann. Amer. Ent. Soc., Vol. VIII, pp. 373–383.

A discussion of the advanced lines of study in entomology, particularly in the departments of diagnostic and descriptive entomology, classifications, distribution, and in economic entomology.

''A New Descriptive Formula.'' Ent. News, Vol. XXVII, pp. 57–58 (Feb., 1916).

An explanation of the construction of shape formula useful for describing the general appearance of Coleoptera and Hemiptera.

''The Efficiency of Spray Machinery.'' Cal. Cult., Vol. XLI, No. 19 (Nov., 1915), p. 451.

Tables are given to enable a sprayer to determine the horsepower secured at the nozzle in a spray outfit and to calculate the efficiency.

''Time of Fumigation.'' Citrograph, Vol. I, No. 1 (Oct., 1915), p. 8.

Answers the two questions, ''Can the time be shortened in machine fumigation?'' and ''How much must the dose be increased if the time is shortened?''

''A New Spray Nozzle.'' Jour. Agr. Res., Vol. 5, No. 25 (Mar., 1916), pp. 1177–1182, Pl. LXXXV–LXXXVI.

A general discussion of the production of a spray by a nozzle and the description of a new type of flat spray nozzle giving uniform distribution of the spray material.

''Proc. School of Fumigation held at Pomona, California, August 9–13, 1915. 192 pp. Published by the Braun Corporation, Los Angeles.

A stenographic report of a course of lectures on fumigation. Contains a full discussion of the current problems of fumigation including the results of unpublished investigations and other material not otherwise available to fumigators.

''Theory of Toxicity.'' Jour. Econ. Ent., Vol. 8, No. 6, pp. 509–512 (Dec., 1915).

The results of 20,000 experiments with cyanide on scale insect eggs show that toxicity increases with geometric increments of time and dose and that in toxic strengths there are three phases, showing a slow increase, a rapid increase, and a decrease of toxicity, respectively.

''A New Fundamental Equation in Optics.'' Science, Vol. XLIII, No. 1119, pp. 824–825.

Gives a rigorously accurate equation for conjugate foci suitable for the calculation of microscopic lenses.

H. D. YOUNG.

''Chemical Analyses of Oranges.'' Proc. 45th Cal. Fruit Growers' Conven., 1914, p. 170.

A summary of the analyses of oranges from the twenty fertilizer plots at the Citrus Experiment Station, Riverside. No evidence was found of a specific effect on the quality of the fruit by the fertilizer used.

''Uniformity of Machine Generation.'' School of Fumigation (edited by C. W. Woodworth), 1915, p. 91.

''The Initial Dose.'' School of Fumigation, p. 135.

Presenting evidence of the uniformly high percent of gas generated in fumigation machines; and discussing the allowance to be made in the first charge for freeing the machine from air.

"Hydrocyanic Acid Gas for Fumigation." Cal. Cult., Vol. XLV., 25, p. 589.

Attention is called to some changes in field practice with fumigating machines subsequent to the author's circular No. 139, Cal. Agr. Expt. Station.

"The Composition of Frozen Oranges and Lemons." Jour. Ind. and Eng. Chem., Vol. VII, 12, p. 1038.

A tabulation of analyses of frozen and sound oranges and lemons. Only slight differences are observed in the percentage composition of the juice, but the quantity in the frozen fruit is very much less.

"Studies on the Relation of Cement Dust to Citrus Vegetation." 1. Effect on Photosynthesis. Biochem. Bull., Vol. V, 18–19, p. 95.

The amount of light excluded by a coating of cement dust is found to be not great enough to interfere with the formation of carbohydrates in the leaf.

FUTURE INVESTIGATIONS

In the paragraphs which follow will be outlined those investigations and activities which neither the station nor the college have as yet been able to undertake for lack of facilities, funds or time. Their perusal will give the citizens of California some conception of the purposes of the organization and enable them to offer constructive criticism and aid in the further development of the Department of Agriculture of their university.

Emphasis can not be too strongly placed upon the fact that what is hereafter outlined is beyond activities that are now under way, and that the fulfillment of this programme rests upon the judgment and support of the citizens of California. Large as it may seem to be, it is believed to represent a constructive, logical and entirely feasible plan wholly within the ability and power of the state to accomplish if it chooses to do so.

ABORTION, STERILITY AND ALLIED DISEASES OF FARM ANIMALS

Diseases of animals which interfere with reproduction have received inadequate attention in this country, especially in California. Thirty per cent of the letters received by this station concerning animal diseases ask for assistance in the prevention or cure of contagious abortion, sterility and allied troubles of cows and young calves. During the past year the staff of the Veterinary Division has devoted to these subjects all the time that could be spared under the present plan of organization, as is evidenced by projects 59, 72 and 315, but these are only feeble attempts compared to the magnitude of the problems to be solved. The work under project 315 has shown that the losses from abortion and sterility are very great. Out of 8463 head of dairy cattle in two counties 15 per cent became barren. There is reason to believe that this was largely due to abortion infection which affects chiefly heifers and young cows. Applying this percentage to the number of dairy cows in the state on January 1, 1915, it may be concluded that over 80,000 of these, mainly the young cows, will become sterile in the next three years. Estimating the loss from abortion or sterility at 30 per cent of the value of the affected animals would place the annual loss to dairymen from barrenness alone at over half a million dollars per year. This does not include losses from abortion and sterility in range cows, which are known to be serious in some sections.

Recent investigations indicate that certain forms of calf scours, calf pneumonia and mammitis are associated with the infection causing abortion and may be due to the same infecting agent. Metritis, retained placenta and similar troubles are always associated with outbreaks of infectious abortion. Sufficient statistical information has been obtained to justify the conclusion that a loss of at least one million dollars a year occurs in California's animal industries from infectious abortion and associated diseases.

Preliminary investigations with a view of determining how expensive a plant will be required for the final solution of the problem are advisable. The projects which should receive immediate attention are:

1. The pathology of infectious abortion in cows with special reference to why sterility frequently accompanies this infection.
2. The relation of infectious abortion to infectious pneumonia and diarrhea in calves and mammitis, retained placenta and cystic ovaries in cows.
3. Study of methods of transmission of these diseases to determine the usual channels of infection.
4. Methods of diagnosis and means of detecting the ''carriers''.
5. Attempts to develop a practical method of producing immunity to infectious abortion.
6. Experiments to discover a cure.
7. Tests of the numerous preparations advertised as preventives or cures for abortion, sterility and diseases of new born animals.
8. Bacteriological and biochemic studies of *B. abortus*.
9. Research in the physiology of reproduction and of the reproductive organs, e.g.:
    - (*a*) The relation of the corpus lutem to fertilization and fetal development.
    - (*b*) The internal secretions of the ovaries and testicles, and their influence on the body.
10. Experiments in artificial fertilization with special reference to the correction of barrenness.

FIELD CROPS

By referring to the outline of projects on pp. 32–45 it will be seen that many field investigations are under way at Davis, at Fresno, in Imperial Valley, and elsewhere, too many, in fact, for the best results with the facilities and funds at hand. The field here for investigation is so large and varied that only a few problems can be mentioned.

In California the influence of climate and season upon the production of corn, beans and potatoes is marked. With these crops more needs to be known of the effect of light and heat. All these crops when planted at the optimum season for their planting may encounter such climatic or seasonal conditions at the time of flowering or during their growth as to inhibit seed or tuber production. In the Imperial Valley all crops grow less during the summer than during the fall and spring. It is not known whether this is due to heat or sunlight. The successful rooting of date palm offshoots is apparently dependent upon the proper humidity in the atmosphere about the offshoots. On the other hand, alfalfa apparently affects the humidity of a particular locality, and therefore may influence the growth of adjacent crops. Elevation has been found to have a determinable influence upon humidity. A certain date orchard has recently been moved, the claim being made that the particular locality was too humid. A study of this whole complex problem is of fundamental importance in California.

Other problems are the maintenance of the organic matter content of non-irrigated soils, the adaptation of drought-resistant grains and forage crops to range conditions and uses; the improvement of varieties of sorghums, beans, potatoes and certain grains and forage crops, and their adaptation to different regions and farm activities. Of the twenty-eight million acres of improved land in California, between fifteen and eighteen million acres are cultivated under conditions which cause the organic matter content to deteriorate rapidly and thereby to reduce its crop-producing power under dry farming conditions.

The discovery of economic methods of restoring this power is probably the greatest problem confronting this station. The causes underlying this condition are fairly well understood. What is needed is an extensive inquiry into economic methods of restoration.

STUDY OF DISTRIBUTION OF CROPS

There is grave need of readjustment of crop distribution in some parts of southern California, and a study of this question looking towards the making of definite recommendations would seem of value.

Large acreages underlain at a depth not to exceed 24 inches with hardpan have been planted to irrigated fruit orchards, and indications of failure are already in evidence. Again, there is a considerable acreage being planted to orchard crops each year where there can be little hope of irrigation. A study of this practice should be made to determine its economic value.

ALFALFA PASTURE

The general scheme for the development of experimental work in feeding animals has been to begin with investigations of the common methods in practice in the state. Obviously the efficiency of alfalfa pasture as a factor in animal production is one of the most vital of these problems. Some progress has been made on the subject with hogs at the University Farm, but nothing has as yet been done experimentally with beef cattle, horses, or sheep. The extent of the facilities required to reach definite conclusions may be suggested by stating that it is believed that at least 155 acres of alfalfa pasture would be required, distributed as follows:

Beef cattle	80 acres
Dairy cattle	40 acres
Horses	20 acres
Sheep	10 acres
Hogs	5 acres

It would probably require five years to reach definite conclusions. The necessary animals would of course have to be provided. But the investigations as to the influence of alfalfa should not be confined to measuring the production of milk and butter-fat, or the gain in body weight, and such changes in conformation as may be shown by a system of measurements. In order to determine whether the composition and digestibility of the rations are such as to secure a maximum efficiency, or whether the feeding of alfalfa in given proportions will result in a normal development of tissues and organs, abattoirs, cold storage facilities and equipment for the study of nutrition problems are essential.

LIVESTOCK DEVELOPMENT

One of the important factors in the rise in the price of beef is the capital required for breeding stock. When beef cattle were largely pastured on government land less capital was required by the beef raiser. Now that land has been taken up and capitalized, it is necessary to have capital both for the land and the cattle. The difficulty in capitalizing dairy cattle and swine is less because of the more immediate and greater returns in proportion to the capital invested.

What applies to the livestock industry as a commercial enterprise applies with equal force to the work of agricultural colleges and stations. It is expensive to equip properly a livestock department. This station never has had and but few other stations have had sufficient funds for the purchase of livestock which would make possible the solution of the problems of breeding in relation to animal production. For this reason the California Agricultural Experiment Station, in common with most others, has confined its efforts largely to feeding experiments with dairy cattle and hogs, or to experiments with lots of steers that could be purchased and sold within any fiscal year, thus avoiding the necessity of a direct appropriation.

In the case of dairy cattle, the station is with reasonable success gradually adding to its herd by keeping the increase rather than by extensive purchases of pure-bred stock. In the case of beef cattle and horses, it has never had enough foundation stock to make an increase a significant possibility.

PROBLEMS IN ANIMAL NUTRITION

A comprehensive study of the livestock industry of the state must necessarily include investigations of problems relating to the feeding of the stock. The problems that confront the California stockmen differ in many ways from those met with in other states, and call for special equipment and employment of trained bio-chemists for their study and solution. Among the topics along this line that await investigation may be mentioned: the digestibility of characteristic California feeding stuffs, and their nutritive effects; the place of the silo in California animal husbandry; the value of grain sorghums for stock feeding; the conditions under which plants of the sorghum family may become dangerous for feeding stock; the effects of long continued feeding of feeding stuffs or rations of narrow nutritive ratios, like alfalfa or alfalfa and cottonseed meal, on the development and production of dairy and beef cattle; the metabolic processes involved in feeding different rations to animals in this state; mineral metabolism of cattle, pigs and sheep; raising dairy calves without whole milk or skim milk; the value of prepared calf meals; also the relative value of whole and ground or rolled grains for calf feeding. These problems along nutrition lines which await investigation must in justice to the livestock interests of the state be studied in a thorough, comprehensive manner by means of methods calling for modern scientific equipment.

RELATION OF THE MOUNTAINS TO THE VALLEYS

There are farmers in California who pay $10 to $20 a year rent for alfalfa pasture in the valleys, and 1 to 2 cents per acre for pasture in the mountains. While perhaps few farmers are related to the industry in this manner, it is not an unfair illustration of the interdependence of the beef, mutton and wool industry upon the mountains and the valleys of California. Cattle and sheep occupy the mountains in the summer and in the winter are fed alfalfa or other hay, and grain or other concentrates in the valleys, such as Imperial, Owens River, Surprise, San Joaquin and Sacramento valleys.

Any development of agriculture in California which tends to disrupt this interdependence makes for decreased efficiency of production. The station is of the opinion that one of the most important pieces of work that could be done at this time would be to study animal production under range conditions in connection with the work of breeding and feeding animals at the University Farm at Davis, and perhaps also at the Kearney Ranch, at Fresno.

There should be on pasture at the University Farm flocks of sheep and herds of beef cattle of sufficient size to produce annually a carload of progeny of each for market. Other lots of similar breeding should be run on the range and the progeny fattened at the University Farm or sold fat off the range. This plan would involve the purchase of livestock and the rental of ranges. About 300 head of cattle and 2000 head of sheep would be required.

ADMINISTRATION OF THE PUBLIC RANGES

In the eleven western states there are over 400,000,000 acres of federal land used as livestock ranges. In addition there is a very great area of privately owned range. About one-fourth of the federal range, an area approximately equal to that of California, is within the national forests. This area carries annually about 15,000,000 animals of all ages. Since the early stockmen of the west started in business the carrying capacity of the public range has been reduced by about 30 per cent through misuse. The Forest Service, which is the only organization that has made a serious effort to solve the problems of the open range, has in the past ten years greatly increased the carrying capacity of the National Forest range by the application of scientific methods. This has been done by developing new methods of herding, by so regulating the time of grazing as to permit natural reseeding, by proper division of the range between different classes of stock, by the construction of driveways, drift fences and water facilities. Although much has been done on the National Forests, the possibilities of the future are greater than the accomplishments of the past. Outside the National Forests, the introduction and development of better methods and control of grazing on the ranges, both public and private, will be of great importance in the production of the nation's supply of meat, wool and hides.

There is a public need and a real demand for men trained to administer the public ranges and to conduct range investigations. It appears that the College of Agriculture, with its facilities for scientific training in chemistry, botany, geology, soils, forestry, animal husbandry, and forage crops, could with a few technical courses on grazing practice and grazing administration meet this need. Such courses would also be of much value to forestry students and to forest rangers attending the short course in forestry.

DAIRY MANUFACTURES

Neither in buildings, equipment, nor investigational and teaching force has ample provision been made for one of the greatest industries in the state, namely, the dairy industry.

The character of the competition in butter and cheese between other states or nations and California is such that unless these products are kept up to a high standard the industry must suffer.

Too much emphasis cannot be placed on the fact that this industry is basic. It affects the raising of field crops, and even fruits. The prosperity of one industry rises and falls with the other. The price of alfalfa hay is directly related to the price of butter-fat; the success of the orchard is often dependent upon the manure from the dairy barn. Time will make this fact more evident.

Many problems on the manufacturing side are of a technical and detailed character, such as the following:

1. A system of business records for the small creamery.
2. Causes of and remedies for defective body in California creamery butter.
3. A study of the value of cream grading in the small creamery.
4. The use of the Pasteurizer in creamery butter making.
5. A study of the methods of cream production in California and means of improving same.
6. A study of the type of cheese curing rooms best adapted to California conditions.

7. A study of the use of the clarifier in improving market milk, milk for cheese making, and cream for churning.

8. Factors affecting texture in ice cream.

9. Effect of improved methods of manufacture on the output of typical farm cheese factories.

10. A study of the best kind and amount of starter to be used in making granular or ''California'' type cheese.

11. A study of the different types of coolers for farm separated cream.

12. A study of California creamery butter (Educational Butter Scoring Contest).

13. A study of California cheese (Educational Cheese Scoring Contest).

14. A survey of the market-milk situation in certain California towns and cities (preliminary data).

15. Study of the cause of butter fading in color (a chemical research problem).

16. Casein manufacture.

17. Cost of production of dairy products.

SANITARY MILK

There is a demand in California for the investigation of several problems in connection with sanitary milk production. Among these are the following:

(*a*) The recent legislation, which is to go into effect in October, 1916, will bring to the dairymen of the state and to this experiment station many new problems. Fairly adequate support is being given to the tuberculin test phase of this industry by the veterinary division, but the problems of grading and pasteurization which will come to our dairymen in attempting to comply with the requirements of the new law should be as effectively met by this station.

(*b*) At present a large number of clarifiers are being sold to dairymen and milk distributors upon claims which are questionable. If investigation were carried out in connection with the use of such apparatus it would be of value to the dairymen as well as to the work in student instruction.

(*c*) The merits of the various commercial starters used for the ripening of cream for butter making deserve more study. There is also the possibility of developing a commercial starter for distribution in California, since none of this material is at present manufactured in this state.

(*d*) The value of different forms of cultured milk and the best methods of preparation are still matters for investigation. Present literature does not give definite information upon the specific organisms suited for the manufacture of the best commercial product.

HOG CHOLERA

During the past five years this station has published one bulletin, four circulars and several technical papers on hog cholera, has manufactured and distributed 6,400,392 c.c. of serum to immunize

160,000 hogs, and has accumulated considerable data which will be useful for publication in the near future. However, the law passed by the California State Legislature of 1911, placing upon the station the responsibility of producing anti-hog cholera serum, did not provide funds for investigations into the many problems surrounding hog cholera, since the law specifically states that the serum must be sold at cost. The point of great importance to determine at this time is whether immunization against hog cholera is really a detriment to breeding swine, and to fix upon, and eliminate if possible, the exact detrimental factor. Some of the other problems to be studied are:

(*a*) Whether it is dangerous to inject virus into cholera-sick hogs which give temperature reactions but show no physical symptoms.

(*b*) The practicability of concentrating and purifying hog cholera serum with the hope of eliminating contaminations and large doses.

(*c*) The causative agent of hog cholera.

(*d*) Practical and efficient disinfection following hog cholera infections.

(*e*) Whether a passive immunity prevents the formation of active immunity.

(*f*) Actual length of immunity from serum alone, the simultaneous and the double or follow-up methods.

(*g*) Hog cholera ''carriers''.

(*h*) The vitality of virus under field conditions.

(*i*) Medicinal treatment of cholera-sick hogs.

POULTRY DISEASES

There are four diseases of poultry which are especially prevalent among fowls in California, and further information is needed upon each of them. The knowledge of methods for controlling poultry diseases is very limited.

(*a*) *Chicken-pox.*—While considerable progress has been made in controlling this disease by vaccination, the method is far from perfect, and much more work along this line is necessary. There are few large flocks in the poultry sections of the state which are not infected.

(*b*) *Roup.*—This is almost as prevalent as chicken-pox, being frequently associated with this disease. The question of the relationship of these two diseases has never been definitely settled; if this point were settled, the development of methods for controlling roup would be facilitated.

(*c*) *Intestinal Worms.*—While considerable work has been done by this station upon these parasites, it has been necessarily superficial, and there is need for further investigations.

(*d*) *Coccidial Enteritis.*—This causes severe losses in young chicks, and no satisfactory method for controlling it has yet been discovered. A practical and efficient method of control would be of great benefit to the poultry industry of the state.

A beginning has been made by the Division of Veterinary Science in investigating these diseases. The first year this work was supported by the contribution of $1000 by the U. S. Bureau of Animal Industry, but the withdrawal of this support on account of the shortage of funds in that Bureau, caused by the great expense of combatting the foot and mouth disease, left this work financially crippled. The diseases of poultry in relation to the proportionate value of the industry exceed in importance the diseases of other animals and less is known concerning them.

DECIDUOUS FRUITS

The value of the deciduous fruit crops equals, if it does not exceed, the value of the citrus fruit crops of the state. The problems pertaining to deciduous fruits are more varied. Circumstances have thus far led the station to give the most study to citrus and other semitropical fruits. The deciduous fruit crops comprise a number of very specialized industries, including prunes, plums, peaches, apricots, pears, apples, cherries, small fruits, almonds and walnuts. The production, handling and marketing of the various crops involve the most diverse problems of soil and climatic conditions. They extend through practically the whole range of pomological requirements. The division for the study of these special problems has only recently been organized and the best procedure for attacking them is just now being developed.

The mere enumeration of some of the most pressing and immediate problems of the deciduous fruit grower will serve to give some idea of the station's responsibility.

Orchard cultivation experiments; reviving old orchards by the use of fertilizers or otherwise; trials of mulching, cover-cropping, fertilizing and interplanting or intercropping; investigations of various stocks for grafting the plum, prune, peach, cherry, apricot, almond, pear, and nuts of different kinds; systematic bud studies to determine time of differentiation from vegetative to reproductive bodies; pruning experiments with prunes, apples, apricots and peaches; sap studies to find nutritive effects of irrigation; pruning and tillage as measured by sugar and starch formation; fruit analyses to determine effects of irrigation on quality of peaches and apricots; twig studies with relation to bud formation and occurrence as influenced by irrigation, pruning and tillage; nature and cause of periodicity in growth of fruit trees; a study of the methods of management and operation in different packing houses; investigations of both cold and common storage of fruits; special studies of the effects of refrigeration; studies of methods of handling and packing different fruits; a complete study of all methods of training and pruning of different fruits; studies on the pollination of fruits with reference to sterility and fruitfulness; improvement of common varieties of deciduous fruits through bud selection; variety tests, including adaptability to shipment and systems of propagation and culture of small fruits; studies of nut growing, including walnuts, almonds, pecans, filberts, chestnuts and pistachios, and a study of the costs of various orchard operations, including also a review of the efficiency of different practices and systems of handling.

SUBTROPICAL FRUITS

The more this station studies conditions in California the more it has become convinced that subtropical fruits are to play a much greater economic rôle than has been the case heretofore. As previously stated, one of the chief functions of an experiment station is to anticipate the knowledge that is likely to be demanded and to be ready to supply that demand when the occasion arises. The study of many little known subtropical fruits should be made not merely to determine their adaptation to the state but to be able to supply reliable information concerning their culture. Thus a study of the cultivated guavas should include a comparison of the large number of species of the guavas which have been introduced into California, together with a revision of the nomenclature. Although pomegranates are grown commercially in California, there is no publication on their culture available in the United States.

In connection with the introduction of such new fruits breeding problems are particularly prominent for two reasons. *First,* success may often be absolutely dependent on the discovery or production of varieties of unusual hardiness, or the combination of hardiness with other desirable qualities. *Second,* most of these fruits have been subjected to so little artificial improvement that the progress of breeding work should be comparatively rapid at first; these fruits are often to be compared with the wild strawberries, cherries, etc., of temperate climates, rather than with the cultivated relatives of those forms.

The first step in the work with these fruits would be the study of the general variety collection, together with investigation of trials of such types by practical growers. Each crop taken up for breeding work should furnish a distinct problem, which might in time warrant a distinct project.

Further collection and trial of varieties would be required with the crops selected. Seedlings of promising forms would furnish further material for selection. Hybridization would be employed, where needed, to combine desirable characters of different varieties, with selection among the new types resulting in the succeeding generations.

This work, dealing mainly with slow-maturing trees and shrubs, would develop slowly, and would require a considerable area for work on any considerable scale.

NEW ECONOMIC AND ORNAMENTAL PLANTS

With the establishment of the Citrus Experiment Station on its new site it will be possible to import and test many new plants, with a view to determining their value for economical or ornamental purposes in this state. These additions will be made from time to time as opportunity offers. It may be confidently expected that in one or two decades valuable additions will be made to the already long list of cultivated plants.

CULTIVATION INVESTIGATIONS

The Citrus Experiment Station at Riverside has under way and planned rather extensive experiments on fertilization. The problems of irrigation are discussed elsewhere. It is equally important that, coupled with these, carefully planned cultivation experiments be started at the earliest possible date. These experiments should include careful studies of various soil treatments and their effects on the physical and chemical qualities of the soil and on plant growth. Such studies are naturally closely related to the similar studies on irrigation and fertilization and should be planned and conducted in close relation thereto. Director Webber, of the Citrus Experiment Station, states that experiments in irrigation, cultivation and fertilization of crops in southern California are in general the most important lines of work that can be taken up, as they are fundamental and have in large measure been neglected. In the case of cultivation, as in the case of irrigation and fertilization, studies carried on with citrus fruits to determine the fundamental principles will apply in a large measure to the same problems with other crops.

IRRIGATION OF CITRUS ORCHARDS

There is probably no doubt that the irrigation of citrus orchards has reached the highest specialization found in any crop, and yet the most fundamental problems are scarcely at all understood. In view of information recently obtained regarding the movement of nitrates in the soil and of the possible injurious effect of alkali in citrus orchards, the whole problem of the application of water requires to be restudied in connection with methods of cultivation and fertilization.

The irrigation investigations most to be desired for citrus fruits may be classified as follows:

1. Optimum amount of soil moisture for different orchard trees in various soil types.
2. Methods and intervals of applying water to attain this optimum.
3. Distribution of various soluble plant foods with different methods of irrigation and different moisture contents.
4. Relation of various cultural practices to the conservation of moisture.

Data gathered for the irrigation season of 1915 show an average application of 12.6 acre inches for the orchards under the Del Monte system, Pomona, as against 77 acre inches for a large block of land near Porterville. Five orchards of close proximity and on very similar soil in the Covina district used the following amounts of water, respectively, during 1915:

1.21 acre feet; 1.35 acre feet; 1.98 acre feet; 2.05 acre feet; 2.20 acre feet.

These figures show that common practice has not determined an optimum amount.

Other data recently gathered indicate that irrigation in mulched basins is decidedly saving of water and that overhead irrigation is of advantage in controlling the distribution of nitrates.

Further information should be gathered on these points through the determination of soil moisture, nitrates and other factors at regular intervals and under varying conditions. Such information should go a long way towards standardizing irrigation practices, both as to optimum moisture conditions and as to the part water plays in distributing soluble plant food. Such a study would apply not only to citrus but to walnuts and deciduous fruits as well. Many walnut and apricot orchards are growing without irrigation, while others are receiving equal amounts with citrus trees.

The amount of water applied must naturally depend upon the nature of the soil, but more largely upon the crop to be grown, with due regard for such atmospheric conditions as temperature, relative humidity and light. Hence fundamental investigations should be made regarding the following factors:

1. The wilting coefficient of several typical citrus soils.
2. The water absorbed by trees under constant conditions.
3. The water transpired by citrus trees:
    (*a*) Under various carefully controlled conditions;
    (*b*) In the field;
    (*c*) At different ages;
    (*d*) At different hours of the day.

4. The relation of water to growth and productiveness:
   (*a*) Effect upon growth and distribution of roots;
   (*b*) Growth of the tree per unit of water used;
   (*c*) Quantity and quality of fruit matured under different conditions.

OLIVE INVESTIGATIONS

Some olive orchards yield a net annual profit of $400 per acre. The average profit is probably under $50, while many are cultivated at a loss. Some of these differences are due to soil and climate, but many are due to variations in culture. The most profitable olives are those large enough for pickling. These constitute probably not more than 10 per cent or 15 per cent of the crop. Improvements of cultural methods are needed to increase the proportion of large fruit and improved methods of manufacture to utilize the small fruit, as indicated herewith.

1. Cultural problems:
   (*a* Pruning.
   (*b*) Irrigation.
   (*c*) Cultivation.
   (*d*) Fertilization.
   (*e*) New varieties.
   (*f*) Grafting stocks.
   (*g*) Nursery methods.
2. Manufacturing problems:
   (*a*) Methods of pickling.
   (*b*) Methods of oil making.
   (*c*) Utilization of by-products.

The impression received in visiting orchards and talking to growers is that they are absolutely at sea regarding the most common details of cultural work which have been worked out for most other fruits. The case of the manufacturing problems is little better. Methods of oil making at the time of the publication of bulletin No. 158 recovered only 60 per cent of the oil contained in the olive. But slight improvement has been made since. Several methods said to be of great value in Europe have not yet been tested here.

Space forbids detailing the various projects under these different heads, but a much needed experiment on pruning olives is here given as an illustration.

I. *Reasons for the Investigation.*—The practice of olive pruning varies within very wide limits. The Italians say, "Prune when the knife is sharp." The Spaniards prune very heavily every third or fourth winter. The French prune moderately every winter. Many growers do not prune at all. All these variations are practised in California.

Published theories of olive pruning are unsatisfactory, being based on supposed analogies with the pruning of deciduous fruit trees, and not on carefully conducted comparative experiments.

There is a strong and apparently well founded belief among olive growers that the quality and quantity, and therefore the profitableness of their crop, depend greatly on the method of pruning, but observations of commercial orchards afford little help in the choice of a method, as both profitable and unprofitable orchards can be found employing many diverse methods.

To obtain exact knowledge of the facts necessary to develop the correct theories on which to base proper practice it is necessary to conduct careful experiments in which all factors but those of pruning are equalized or excluded.

Such experiments to be conclusive must extend over the formative period of the young tree—5 to 7 years—and over an indefinite number of years of bearing age. They should include a sufficient number of trees to substantially eliminate accidental errors, and the conditions of soil, climate and irrigation should be as uniform as possible.

II. *Points to be Investigated.*—The principles of pruning appear to have been established in the most adequate manner in the case of the vine. For this plant it has been shown that (1) winter pruning affects the form of the young vine, but has no effect on its total growth or vigor; (2) winter pruning affects the form of the bearing vine and also its vigor, in the latter respect roughly in proportion to its severity; (3) this effect on the vigor of bearing vines is a consequence of the effect on the bearing, which is inversely proportionate (within limits) to the severity of the pruning; (4) summer pruning affects the form of all vines and is weakening in direct proportion to its severity.

Some recent experimental work with deciduous fruit trees indicates that these conclusions may not apply exactly to all. It seems also, *a priori*, probable that they would apply even less exactly to evergreen trees, such as the olive, whose condition of dormancy in winter is less complete.

The most important general questions to be answered are indicated in the following scheme:

Effects of various methods and degrees of pruning on:

A. Young trees in respect to: (*a*) vigor; (*b*) rapidity of development; (*c*) form. B. Bearing trees in respect to: (*a*) fruitfulness; (*b*) quality of fruit; (*c*) regularity of bearing.

III. *Methods of Procedure.*—Five acres of suitable uniform land at Davis or elsewhere would be planted with well grown nursery trees raised at the farm. Planted 30 feet by 30 feet on a piece of land 600 feet by 360 feet would give 12 rows of 20 trees each, or 240 trees. This orchard should consist of two blocks planted respectively with Mission and Ascolano, because these appear to be the most suitable varieties for California and because in many ways they represent different types.

The pruning experiments would then be made as follows:

1. *Young Trees.*—(*a*) At each annual winter pruning remove all leaves, having in view only the form of the tree. (Conform as nearly as may be to the usual method of pruning peaches.) This pruning is to be continued until the skeleton of the tree is complete and large enough for bearing.

(*b*) At each annual winter pruning remove as few leaves as possible while still causing the tree to attain the desired form.

(*c*) Omit all winter pruning and shape the tree by means of frequent pinching and removal of small shoots during summer.

2. *Bearing Trees.*—(*a*) Cut back and thin out in proportion to the vigor of the part pruned. Average removal, three-quarters of the annual growth.

(*b*) Ditto. Average removal, one-half.

(*c*) Ditto. Average removal, one-quarter.

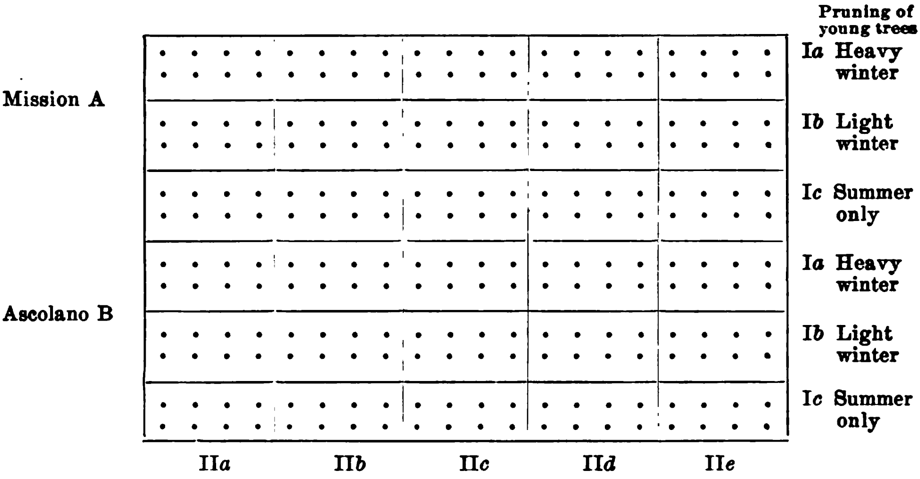
(*d*) Thin out; always cutting out twigs, shoots or branches at the base. Cut back only where growth is weak.

(*e*) No pruning except the removal of branches which would interfere with cultivation.

The arrangement of the experiments is shown in the accompanying diagram.

OLIVE ORCHARD FOR PRUNING INVESTIGATION

5 acres; trees 30 ft. by 30 ft.



PRUNING OF BEARING TREES

II*a*. Heavy winter. Cutting back three-quarters.
II*b*. Moderate winter. Cutting back one-half.
II*c*. Light winter. Cutting back one-quarter.
II*d*. Moderate winter. Thinning out.
II*e*. None.

METHODS OF GROWING RAISIN GRAPES

The average crop of raisins in Fresno County, according to the 1914 Report of the State Statistician, is about .7 tons per acre. The average crop of the Kearney Vineyard for the last four years has been 784 tons on 740 acres, or 1.06 tons per acre.

In the Kearney experiment vineyard the following crops have been obtained:

	Age	Grapes, Lbs. per vine	=	Raisins, Tons per acre
A. *On single vines*—				
Muscat ungrafted	4	52	=	4.51
Sultanina on 1202	4	94	=	7.44
Sultana on 41B	4	82	=	6.37
B. *On single rows*—				
Muscat ungrafted	4	25.4	=	2.20
Muscat ungrafted	5	33.0	=	2.86
Sultanina on 1202	3	36.0	=	2.81
Sultanina on 1202	4	49.5	=	3.85
Sultana on 41B	4	58.9	=	4.58
C. *On a single block (2 acres)*—				
Muscat ungrafted	3	7.6	=	.66
Muscat ungrafted	4	15.7	=	1.35
Muscat ungrafted	5	21.3	=	1.85
*Sultanina grafted	4	......		2.50
*Sultana grafted	4	......		3.00

* Crops of block Sultanina and Sultana calculated from the data obtained by observation.

These results indicate that the average crops of raisins in Fresno County could be increased, and that for the conditions of the experiment vineyard a reasonable estimate of the crops which should be obtained from vineyards in full bearing are: Muscat, 2 tons; Sultanina, 2½ tons, and Sultana, 3 tons per acre.

It is estimated that at 4 cents per pound for the raisins a crop of three-quarters of a ton will yield interest and profit on the investment and operations of about $35. A crop of two tons per acre would, therefore, yield by the same calculation $118 per acre, the increase in net profit being greater than the increase in gross returns.

The heavy crops of the experiment vineyard were due principally to:

(1) The use of fairly good soil.
(2) The adoption of good methods of planting, pruning and harvesting.

As these tests were made on a small scale, and to some extent with specially expert workmen, they are not thoroughly convincing to the grower. It would therefore be desirable to demonstrate how nearly these results can be approached on a large scale under expert supervision with a careful choice of good soil and untrained labor.

PRESERVATION OF VEGETABLE AND FRUIT PRODUCTS

The term zymology, as used by this station, for lack of a better word, includes all those industrial processes which depend for the preservation of vegetable or fruit products on utilizing or preventing the work of micro-organisms. With this definition the subject includes a very large number of lines of useful endeavor. Certain lines, such as the manufacture of wine and of vinegar, have received a great deal of attention and are not in any great need of further work. The principal need in these lines is to instruct those engaged in these industries in the improved methods already demonstrated.

In other lines, such as the preparation of fruit juices, the utilization of fruit by-products, something has been done, but this work has been much hampered by limited facilities which the building of Hilgard Hall will correct. The principal lines of endeavor or special problems are:

1. The collection of data regarding the present organization and equipment of canning, preserving and pickling establishments, especially those of a co-operative character. This would be useful in itself and is almost necessary before outlining any comprehensive series of investigations. It is of the same character as that already partly done for citrus by-product establishments and olive pickling and oil works.
2. Further work on citrus by-products.
3. Trial of the Monti concentration system for fruit juices.
4. A large number of investigations in canning, preserving, utilization of vegetable wastes and by-products, which are too numerous to mention but which in the aggregate are of great importance.

THE CURING AND SWEATING OF LEMONS

The methods at present used in the packing houses are little understood, and the principles on which they are based are not certainly known. It is thought that much of the fruit decay in storage and during shipment is caused by improper curing. Certain improvements in the methods would undoubtedly produce a better quality of fruit, as well as obviate a part of the present losses.

The investigation should include:

1. A physiological and chemical study of the changes occurring in the fruit in the process of curing, such as:
    - (*a*) The acid and sugar content;
    - (*b*) The amount and character of volatile, aromatic oils;
    - (*c*) The gases given off in respiration;
    - (*d*) The presence and action of various enzymes.

2. The effect of various factors upon the curing process:
   (*a*) Temperature;
   (*b*) Humidity;
   (*c*) Gases.
3. The best application of principles to packing-house conditions.

BULBS AND SEEDS OF FLOWERING PLANTS

No other flowering crop has been the cause of greater inquiry during the past year than bulbs. Such inquiry has come, *first*, from people already growing bulbs in the state, who want more detailed advice and assistance; *second*, from others in the state who wish to take up bulb growing but have had no previous experience; and *third*, from many people in other states who wish to settle in California and grow flowering bulbs.

At present all data and information concerning this industry is very general, and there is a very keen demand for more and accurate data concerning sections of the state, soils and climates best suited to bulb growing, present acreage now under cultivation, cost of production, varieties grown and methods of propagating, planting, irrigating, cultivation, curing and marketing.

Perhaps of equal importance and an industry that needs investigation in the same way is that which is concerned with the production of flower seeds in California. The bulk of the sweet pea seed now used in the United States, and much that is exported, is grown in California. Seeds of many other flowering plants are being grown with equal success, and there is just the same lack of definite and accurate information concerning this industry that there is in the case of bulbs.

FIG CULTURE

The many questions in connection with the fig industry which have been received from persons pursuing the Correspondence Course on Figs serves to emphasize the need of investigation upon this important and interesting crop, the basis of an industry capable of indefinite expansion.

Some of these questions are as follows:

1. How do differing climatic conditions affect the cropping characteristics of different varieties of figs?
2. What varieties are best adapted to shipping fresh in different fig districts of the state?
3. What is the cause of the splitting of figs?
4. What are the conditions which result in figs souring on the trees?

RICE CULTURE

Comprehensive field experiments on rice culture are being conducted near Gridley by the United States Department of Agriculture, thus relieving this station of the necessity for such investigations. Studies of the duty of water in rice irrigation are being made by the division of irrigation investigations in co-operation wth the State Water Commission of California.

A complete survey of the rice industry in California has recently been made by W. W. Mackie, a graduate student in the college of agriculture, who has been in touch with the industry since its inception in this state. The results of this study will soon be published as a circular of this station. Chemical studies are now needed, especially with reference to the several by-products resulting from different methods of milling and demonstrations as to adaptability and methods of culture in certain sections (such as Imperial Valley) not now extensively raising this crop.

ALKALI RECLAMATION

This subject is being attacked from many angles by the station. One hundred and fifty acres of land on the Kearney estate have been reclaimed by tile drainage, and many chemical studies have been made, a preliminary report on which is soon to be published.

In pot and plat experiments marked results have been obtained in the neutralization of alkali, and in the production of barley and alfalfa by merely sprinkling the ground with commercial sulphuric acid. The use of sulphuric acid, however, can not be recommended to the public until trials have been made on larger tracts to determine the economic phases of the question. This involves the expenditure of considerable money, and for this reason the station has not been able to carry the work to completion.

In like manner some striking results have been obtained in the use of manure in alkali reclamation. Here again the station has not been able to determine the effect of large quantities of barnyard manure over areas sufficiently large to determine whether or not it can be profitably so employed.

SOIL SURVEYS AND CROP MAPS

As stated on page 48 of this report, this station is making a soil survey of California, working in co-operation with the Bureau of Soils of the U. S. Department of Agriculture.

The station has recently inaugurated the plan of making crop maps of all the areas surveyed. Whenever possible these crop maps will be made at the same time the soils are studied. When this is impracticable it is intended to make crop maps after the soil map is completed. The crop map of the Ukiah and Healdsburg areas, covering the Russian River Valley, will be the first to be undertaken. It will give needed data on the possible utilization of the lands now devoted to wine grapes, should the occasion for this information arise.

DRAINAGE INVESTIGATIONS

At the present time, under co-operative agreement with the office of Public Roads and Rural Engineering of the U. S. Department of Agriculture, the station is making drainage studies of field problems as they arise, advising farmers regarding the problems of drainage, and in many cases making surveys and estimates for the work, and if conditions warrant, overseeing the installation of the system. Specific studies of orchard drainage and of tideland reclamation are needed. There is particular need for drainage investigations in the rice growing districts and in Owens and Sierra valleys, as well as of the great problems of the Sacramento and San Joaquin valleys. There is immediate need of installing an experimental drainage system in the Imperial Valley, which need not be expensive.

IRRIGATION INVESTIGATIONS

California being almost entirely arid or semi-arid, the growing of nearly every crop involves problems of irrigation, many of which are intricate. Attention has already been called to the information immediately needed about the irrigation of citrus orchards, and most all of what was said may be applied with equal emphasis to deciduous fruits. The Division of Experimental Irrigation, working in co-operation with the Office of Public Roads and Rural Engineering and the California State Department of Engineering, has long recognized the pre-eminent need for gathering fundamental information about the irrigation of orchards and has already begun it in connection with deciduous orchards of northern and central California. With the funds now available, however, but relatively little progress can be made toward the acquirement of fundamental data, because what is most needed is a suitable area of land, free from danger of underground water and with soil of uniform texture, on which to conduct a long-time experiment. The acquirement and dissemination of information about methods of orchard irrigation has value, but the big problem is the moisture requirement of orchard trees on different soils and the effect of different quantites of moisture at different times through the season on the various tree processes, such as the growth of twigs, development of fruit buds, setting of fruit, development of the pits of stone fruits, sweetening and ripening of fruits, and their canning, shipping, and drying qualities and their general attractiveness and flavor.

While the most virgin field for irrigation investigations along agricultural lines in California is found in the orchards of the State, the need for fundamental research is also urgent in connection with field crops. After years of effort California has at last entered upon the public administration of its irrigation water supplies, and with the growing scarcity of water in many sections of the State the pressing need for more carefully differentiating water duty on the basis of individual crops and local soil types and conditions is becoming more and more apparent. The water requirements of alfalfa have been studied for six years at Davis, for three years on farms scattered over Sacramento Valley, and for two years on farms in Imperial Valley, but what has been done in connection with alfalfa is needed equally for other field crops. The division has made good progress in gathering and disseminating information about *how* to irrigate these crops, but has been unable to accomplish the research necessary to show *how much* water is actually needed and *when* it can best be applied.

The unsolved institutional and engineering problems of irrigation are also numerous. Speaking merely of the latter, and of only a single phase, it may be said that at the last census of irrigation, in 1910, there were approximately 10,000 irrigation pumping plants in California. This number has much more than doubled since then, but the divison has been unable to give more than cursory assistance in helping to guide this development along right lines. A reconnaissance study of these pumping plants recently made shows a very wide diversity of installations and economy and discloses many uneconomical practices that are greatly increasing the pumping costs to individual irrigators. The station should be able to ferret out and give wide publicity to these uneconomical practices and to supply definite and practical information on how to eliminate or to correct them.

RURAL INSTITUTIONS

Recently the college of agriculture has organized a Division of Rural Institutions. In this attempt to help create institutions suited to present requirements the college is dealing with questions that have become acute only within recent years. It aims to bring, in a constructive manner, the institutions, opinions and economic methods of farmers into proper accord with the requirements of modern industrial life.

America is just emerging from the pioneer stage. This has brought new problems to the American farmer. While men engaged in other industries have been making wider and wider combinations, he has attempted to adhere to the traditions and tendencies of the past and to remain an individualist. The advantages of co-operation and organization have not been utilized as fully as in other pursuits, in part because the control and restraint necessary to success are a departure from past traditions and practices. The result is that the paramount needs of American agriculture are not wholly in the direction of improvements in methods of crop production. Social and economic conditions are assuming constantly increasing importance. This is illustrated by the reports of four commissions appointed by the governors of New York, New Jersey, Delaware, and Maine to report on the most urgent needs of agriculture in their respective states. Out of from 9 to 13 items included in these reports all contained the following six:

1. A readjustment of existing methods in distributing, marketing and delivering farm products.
2. Co-operation among farmers in the wholesale purchase of supplies; study of market requirements and full carload shipments.
3. A simpler and cheaper means of borrowing money for the acquirement and operation of farm lands, for permanent improvements as well as seasonal operations.
4. Better roads in the country, particularly side roads, which branch out from the farms away from state roads, and a larger use of the parcel post.
5. Community efficiency and co-operation with storage warehouses at centers of population, and auction sales of farm products.
6. Better agricultural education for adults and children.

LAND SETTLEMENT

While the agriculture of California would be benefited by improvements along all the lines above enumerated, there are certain other factors here of special urgency and importance. First among these is the introduction of a better system of land settlement. Within this state are two million acres of irrigated or irrigable land, unused and unproductive for lack of settlers. There are also millions of acres of other agricultural lands, including large areas of cut-over timber land, which are capable of supporting an immense population, but which have now little productive value. The natural advantages of the state make it possible to establish on these areas rural communities which will maintain the best of past traditions in American life. The climate and soil make possible a wider and more varied agricultural development than can be secured in any other part of the country. But to make the best use of these advantages there is need of a definite land settlement policy in which the public welfare rather than private gain will be the governing consideration.

The importance of this reform can scarcely be overstated. These are pregnant years when institutions are forming. The character of the settlers who are to form these new communities, the spirit and purpose in which they enter into the development of the state's latent resources, the creation of the kind of agriculture best suited to the soil, climate and markets of different localities, will all have a vital influence on the social conditions of rural California, on the prosperity of the farmer, and on the value of its productions.

While recognizing the great enterprise and public spirit which has done so much to bring the state to its present position, it is believed that in recent years the purchase and subdivision of lands has been attended by an evil of constantly increasing magnitude. This is the growing element of speculation in land buying and land selling. The desire for a "quick turn" out of an inflation in prices is causing the productive value of land to be disregarded. The result in too many cases has been an ephemeral prosperity followed by stagnation, with a large loss to credulous and over-sanguine settlers.

Such methods are wasteful and unscientific and ought to be changed. The settlers who buy farms in new districts should feel that they are entering on the creation of a community which is to be the home of themselves and their children, and should have reason for confidence in its enduring prosperity. To instill that spirit into beginners and give the needed confidence many things not now attempted are required. The protection of the irrigated farm from being ruined by seepage or alkali; the decision as to whether a locality is best suited to fruit growing or dairying and stock raising; the expense of converting raw land into cultivated farms—all are matters which should be settled before men have built their houses and spent their money, rather than to be learned afterwards through the costly school of experience. In other words, land settlement should be under state control. There is greater need for this than for the valuable oversight of corporations now exercised by the Railroad Commission.

The first step towards such action is the collection of information on the productive value of land, the size of farm needed to make a living area, the indispensable expenses of improvement and equipment, and what the state should do and can safely do in the way of aid and direction of settlers of limited means. It is believed that the result of these investigations when made public will exercise a great influence on future development.

THE FARM LABORER

This station should in the near future take an active part in inaugurating a plan for improving the condition of the farm laborer. The casual and uncertain character of his employment forces him into either a migratory life or into long periods of enforced idleness. Home ties are weakened and the influences that help to make good workers and good citizens out of this important class need to be strengthened. One of the most valuable features of the Australian closer settlement system is the two-acre home created for the married farm worker. This enables him to raise most of the food his family consumes, and gives him employment on what would otherwise be idle days, ties him to the soil, makes him an independent and interested member of the community. The college can do this state no greater service than through helping the farm laborer and his family to achieve a definite and self-supporting status.

THE FARM HOUSE

Naturally and properly, the character of the rural population must ultimately rest in the human satisfaction that is to be found in the rural home. Its comfort, its convenience, its appeal to the higher instincts of the race are all factors which need to be studied. But little fundamental study has been given to the influence of certain factors in modifying temperature, in obtaining cleanliness in buildings, clothing and person, or to the influence of light upon migration to the cities. The whole question of the adaptation of buildings for persons and animals to the environment of the various California climates needs to be studied and our building programme recast in accordance with experimental data. For example, in order to determine how to reduce dust in country houses to the minimum, it is necessary to know how far particles of matter of given size will travel in a given rate of wind. It is only by such basic information that the house and its surroundings can be planned to give the maximum of comfort and enjoyment. The constructional features of water supply systems, sewage disposal, plumbing, heating, lighting and ventilation need to be developed to meet farm needs.

COMMUNITY IMPROVEMENT

In this land of perpetual flowers and of evergreen trees much has been accomplished in beautifying homes, in embellishing streets, and in the creation of parks in cities and towns. Much less satisfactory results have been obtained in the open country. Some of the reasons for this state of affairs are not far to seek, others are less clear.

Nevertheless, here lies a great opportunity to add to the comfort and enjoyment of the people, as well as to the reputation of the state.

Two distinct steps appear necessary: *First,* a study must be made of the adaptability and best use of plant varieties. Data must be collected, for example, concerning roadside trees for rural districts; the planting and care of windbreaks for country homes; trees adapted to corral planting for summer shade; the best shade trees for country homes; the best vines for quick and permanent effect on the farm. The problem of plant adaptation is of greater importance in California than elsewhere because of the extensive flora both native and exotic, and the varying soil and climatic conditions. *Second,* having obtained definite concrete information on these and similar points, community planting programmes should be organized. One attractive home, because of the contrast, is not a great asset to a community, but twenty such homes are of inestimable esthetic and economic value.

By means of the farm bureaus it should not be difficult to improve greatly the appearance of the country homes of California.

Many requests have been received by the college of agriculture for planting plans, particularly for school grounds. So far as time would permit, the Division of Landscape Gardening has complied with these requests. Often such requests, however, are the result of a temporary wave of enthusiasm. After the plans are supplied they are pigeonholed either because the excitement is over or because the recipients do not know how to begin, or what to do with the plans after they get them. There must be a definite and carefully organized effort before permanent results can be obtained with living things.

DISTRIBUTING AND MARKETING FARM PRODUCTS

The distribution and marketing of farm products is a matter of special importance in California, because this state grows such a variety of high-priced crops, and because of the distance to the great markets of the world. Everywhere in America the distribution of agricultural crops is inefficient and costly, and the margin between the price the producer receives and that which the consumer pays is greater than prevails in countries in which co-operative organizations for buying and selling practically control the situation.

The problems of California are not, however, confined to the problems of distribution to distant markets. There is even greater need of a less complicated and more effective system of distribution in cities—some way to bring the producer and consumer into more direct relation, especially in such articles as milk, fish, meat, fruit and vegetables.

COST ACCOUNTING

There is probably no type of investigation beset with so many difficulties as that connected with the cost of production of farm crops. Attempts to determine whether, as a whole, a particular agricultural industry is profitable or not are of little value, and statements commonly made about such matters are of less value. The basic reason for this condition of affairs is that a large element of the profitableness of an agricultural industry is the capital invested in the real estate. The value of the real estate fluctuates with returns from the land. The universal tendency when an increase in gross returns occurs is to recapitalize the investment, particularly the land, so as to absorb all profits beyond a comparatively low rate of interest. The reason that land is capitalized so as to earn such a low rate of interest is due to the fact that productive land constitutes one of the safest securities, if not the safest security known. As Governor Herrick says: "Mansions may become boarding-houses; factories fit for nothing, but fertile soil will have a value as long as civilization lasts."

However, the cost of farming operations under standard conditions can be determined, and this knowledge may be of great value in planning an efficient system.

Investigations into the possibilities of reducing the cost of producing orchard crops might well be undertaken, especially along the following lines:

(*a*) The possibility of producing co-operatively a considerable portion of the fertilizer used in the form of coarse organic matter.

(*b*) The increase in average acreage cultivated per animal through co-operative ownership of work stock.

(*c*) The possibility of diversified orchard crops either by intercropping or by the use of more varieties of fruit in solid blocks, thus making each district nearly self-supporting. The study of intercropping as a part of orchard management would be of especial value in case of walnuts, for the indications are that considerable space may be left between the trees without materially decreasing the per acre production of nuts.

(*d*) In case of the apricot crop particularly, a study of the possibility of co-operation in drying, packing and selling should prove of great value to the industry.

OBSCURE PLANT DISEASES

There are many plant diseases of great economic importance which seem to have little relation to known principles. An example of such plant troubles is the widespread and serious disease of peaches known as "little leaf." The same or a similar disease attacks many other trees. Sour sap of stone fruits and apples and the so-called "black heart" of apricots are also illustrations of this set of plant troubles. The nature and control of these obscure diseases are quite unknown. No rational control is possible until the fundamental factors underlying them are discovered. Such diseases seem to be of unusually wide occurrence and particular importance in California. The work surrounding this study is slow, laborious, expensive, and often without tangible results.

CONTROL OF PLANT DISEASES

There is an urgent demand in the state for information as to the means of control of different diseases, both of orchard fruits and other crops. This information can be gained only by systematically conducted field experiments. Examples of such problems may be found in apricot diseases, cherry diseases, apple and pear diseases, cereal diseases, nursery stock diseases, and the disease of florists' crops. Whenever facilities are available for organizing this work it is believed that the county farm advisers will be able to co-operate effectively in carrying out some of these investigations.

THE CODLING MOTH

No studies have thus far been made on the codling moth under the conditions for apple growing in southern California. The life history of the insect in this part of the state needs to be worked out in order that spraying may be more intelligently done.

During the past two or three years the codling moth has greatly increased in its attack on walnuts, 10 per cent of the nuts have been infested in several instances and, in a few cases, the amount of wormy nuts has been 25 per cent. The control of this insect on walnuts presents an entirely different problem from that in apples.

THE SUSCEPTIBILITY OF TRUCK CROPS TO THE ROOT KNOT NEMATODE

The damage caused by the root knot nematode on vegetables and various crops is rapidly increasing, and no successful control method is known other than planting infested land with crops that are not subject to the attack of the pest. The list of susceptible plants heretofore published has not been based on California studies and is only in part applicable to conditions in this state.

DISEASES OF TROPICAL AND SUBTROPICAL FRUITS

The rapid increase of new fruits, such as the avocado, date, feijoa, guava, loquat, and the like, is leading to the introduction of a number of new diseases on which information is being sought.

Already a bark rot, bark canker, and a leaf scald or spot are causing considerable damage, and need investigation as to their cause and control. A canker and a scale bark condition of the loquat has also attracted some attention. The investigation of such diseases early in the development of the industry might lead to their eradication and save the industry very great damage.

DECIDUOUS FRUIT DISEASES

Very urgent demands have been made during the past two years by the rapidly increasing deciduous industry of southern California for relief from some destructive diseases. The probability is that such demands will increase rather than decrease, as already some new diseases are entering the newly planted sections and some old ones are becoming more destructive. Apricot diseases are attracting more attention and causing more damage in southern California than at any time in the history of the industry.

Studies have been taken up on two diseases of the apricot with a view to finding practical preventive measures. These are rust and fruit spots.

WALNUT ROOT ROT

A root disease of walnuts budded on native black roots has become a problem of importance in Ventura County, and in one place in Los Angeles County. Investigations as to its cause and control are greatly needed.

DROPPING OF FRUIT

The cause of the abnormal dropping of fruit at the time of setting fruit in the spring continues to baffle investigators. The California State Fruit Growers' Convention passed a resolution asking this station to investigate the problem, which it is now doing in a limited way.

DISEASE-RESISTANT VARIETIES

A great deal of attention has been given by investigators in the United States and Europe to the study of disease-resistant crops. Thus far little of a practical character has resulted so far as it applies to staple field crops. It is one of those questions, of which there are many in agriculture, in which the investigator takes a long chance of getting results. However, the subject is one of such profound importance that if the question could be solved by fifty years of laborious study it would be quite worth while.

In California the control of stem rust in wheat, barley, and oats through the introduction of rust-resistant varieties would be of vast economic importance to the state.

The procedure for the study of this problem would consist of (1) growing many local and introduced varieties under conditions favorable to the development of stem rust; (2) selecting individual plants showing disease-resistance; (3) hybridizing species and varieties, some of which are to be partly or wholly resistant to stem rust; (4) testing under field conditions the most promising selections; and (5) distributing the best strains for trial throughout the state.

PLANT DISEASE SURVEY

Every plant pathology laboratory should have available data regarding the occurrence of all plant diseases of agricultural crops, and if possible ornamentals also in the sections to which its services are devoted. This material is not only valuable for reference but the act of accumulating it puts the laboratory more quickly in touch with any new and possibly serious diseases which may appear. Considerable of the work connected with such a survey will be done by members of the staff from time to time as opportunity offers.

THE NUTRITION OF PLANTS

As a basis for the fundamental scientific knowledge of the nutrition of plants, the artificial propagation and study of the selective action of seaweeds offers a fruitful field of attack. Seaweeds have apparently greater power of selecting their foods than have land plants. Furthermore, their structure is comparatively simple. The cause of selective power could probably be more easily determined than from land plants. The results, however, could be applied to the latter and might explain obscure points in plant nutrition.

EVALUATION OF FARM MANURE

The agricultural value of farm manures bears no definite relation to their plant food content, because the chemical effect of the plant food elements may in some instances be overshadowed by the physical effect of the mass of organic matter present. It is thought that a rational evaluation of farm manure may include index figures for fiber, non-fibrous organic matter and nitrifiability.

SALTS IN IRRIGATION WATERS

The amount of salts which an irrigation water may carry and still be without injurious effects on crops varies with the kinds of salt present and the type of crop and soil. On account of the great variations in all these factors definite opinions as to the effects of irrigation waters are not to be expected from present data. A further field and laboratory study of the toxic limits of the mineral constituents in different amounts and combinations is much needed.

This is of special interest to areas subject to tidal influence.

THE INOCULATION OF LEGUMES

California produces a large variety of cultivated and wild leguminous plants, among them alfalfa, bur clover, sweet clover, bitter clover, vetches, peas, common beans, horse beans, cow peas, and soy beans.

These plants are a great asset to the state in helping to maintain the nitrogen supply of the soil, as well as in producing food of high value.

Notwithstanding the ease and even luxuriance with which these plants grow in California, or perhaps because of it, perplexing practical questions concerning the inoculation of legumes have arisen. Does it pay to inoculate a legume which already shows nodules on the roots? Is there any true specificity of organisms among the common clovers and alfalfa, or among vetches and beans?

This station has been recommending a simple and inexpensive method of soil inoculation to be used in case of supposed or real need. While this method is known to give satisfactory results in case of real need, it is desirable to determine whether there may not be a better method.

SOIL STUDIES

Through brilliant researches of the late Dr. Hilgard and his coworkers this station has been known throughout the world for its soil studies. It appears, however, that the more fundamental processes within the soil are as yet little known. To what extent, for example, is the humus content of the soil influenced by straw mulching, or by such systems as that of Gerăldson of Newcastle? These methods evidently have the reverse effect upon the physical condition of the soil from the dust mulch and clean tillage system, but neither the direct nor ultimate effects are known. Systems of soil management should be planned and studied in order to determine the proper methods of maintaining the best soil condition.

As time permits studies of the physical features of soils will be made, such as volume-weight, hardpans, plow-pans, adobe soils, erosion (both wind and water) and water requirements of soils.

FORMS OF NITROGEN

Considerable data have been recently accumulated by different investigators on the subject of the form of nitrogen which plants will assimilate without harm, which seem to point to the fact that the old ideas on nitrates as the only form requisite to the proper nutrition of plants must be changed. In fact, it appears that some plants will get along much better on forms of nitrogen that are not nitrates. This may be involved in some of the nitrogen nutrition difficulties which have occurred with certain crop plants in this state. For that reason it should be determined definitely through plants grown under sterile conditions in nitrogen-free sand, what particular form of nitrogen is best suited to produce a normal plant growth.

THE SOIL SOLUTION

Studies on new methods for obtaining the soil solution are necessary for the purpose of determining how much plant food throughout the year is actually in solution in the soil and at the disposal of plants; how fertilizers affect the strength of this solution; how the factor of antagonism between salts comes in to render soil solutions of certain strength innocuous, whereas they might otherwise be damaging; how the percentage of water in soils is related to the strength of the soil solution, and the utility thereof. Several new methods of obtaining the soil solution seem to give promise at the present time of good results. Such methods should be developed and tested out fully.

SOIL BACTERIA

All attempts at inoculating soils with bacteria other than the legume bacteria have thus far practically ended in failure. It is known beyond question that bacteria are the real makers of available plant food, and in the case of nitrogen, also providers of additional plant food. It should therefore be possible, at least theoretically, to inoculate soils with bacteria possessing high solvent powers for the purpose of making available the minerals of the soil. Experiments on such inoculation work should be instituted at first on a small scale, and then on a larger scale, to determine to what extent the total soluble nutrient salts of soil can be increased.

Results which are now being obtained in the greenhouse seem to indicate that the failures which have been made heretofore in the inoculation of soils with Azotobacter have been due more largely to the method of inoculation than to any other cause. Satisfactory results with sandy soils which are deficient in nitrogen have been obtained, but it is still to be tested out on a larger scale on plots in the field, in order to determine whether these non-symbiotic nitrogen fixing bacteria may be used practically to supply nitrogen to the soil, whether the latter be cropped or not.

THE NUTRITION OF THE CITRUS TREES

The cost of fertilizers for citrus groves in southern California is second only to the cost of water, though in some cases the former is greater. It is well understood that a fertilizer applied to the soil may benefit the tree in several ways without serving to any appreciable extent as a nutriment. Therefore fertilizer tests, of however great benefit, do not necessarily solve the problem of plant nutrition. It might be said that the study of nutrition begins where fertilizer tests end.

The question of citrus nutrition seems especially important on account of several serious maladies which at present are regarded as "physiological disease" or as "malnutrition."

Some of the important problems for study are:

1. The value of various compounds containing elements regarded as necessary for nutrition.
2. The metabolism of the tree in its relation to nutrient elements absorbed.
3. The relation of essential and non-essential elements to maladies prevalent in the citrus tree, with especial reference to concentration of salts, seasonal conditions, excretions of substances from roots, etc.

BY-PRODUCTS

The development of commercially valuable commodities from the by-products of California industries, notably of the lumber industry, offers a rich field for investigation. Many materials are not usefully applied because private individuals cannot go to the expense of determining their uses and limitations. To determine the practicability of profitably utilizing common by-products such as grape and olive pumace is a proper function of experiment station work.

LOGGING METHODS AND EFFICIENCY

It is desirable to study the cost factors of the different parts of a logging operation in detail, with a view to determining how greater efficiency can be secured. Any reduction in logging costs which can be attained means a direct increase of the wealth of the state. For example, a saving of only 10 cents per thousand board feet means, on a basis of the present annual cut, an annual saving of $125,000. Or, looking at it from another standpoint, if, as is often stated, each reduction in the cost of manufacture is equivalent to an equal increase in stumpage value, each saving of ten cents per thousand board feet means an increase in value to the timber resources of the state of $38,000,000. Such increase in wealth would probably accrue not entirely to stumpage holders, but in part to timber operators and other employees, and in part to the ultimate consumer.

To attack this problem with thoroughness requires a large amount of research. Using the methods of the efficiency expert, the basis must be stop-watch observations on each step, taken under widely different conditions, accompanied by a detailed analysis.

TREE GROWTH

Reliable data on the rate of growth of different species under various conditions are entirely lacking for California timber species. Definite knowledge of how fast second-growth timber may be expected to grow is absolutely necessary before the state, counties, cities and towns, and permanent corporations such as railroads, lumber companies or water and power companies can be adequately committed to the policy of raising permanent crops of timber on the non-agricultural lands of the state. This is one of the foundation stones for insuring permanent forest management by all classes of forest owners. The securing of the necessary data requires small crews of men working throughout the field season for several years.

VOLUME TABLES FOR CALIFORNIA TREES

Volume tables show the contents of standing trees of various sizes and species. Reliable volume tables for California species are not in existence. Such tables should be made as soon as possible. They will enable the buying and selling of timber land on a better basis, make it possible to adjust tax assessments with greater ease, and to obtain a better inventory of the timber resources of the state. A large number of individual trees must be measured in the preparation of these tables, and this can be done economically only by the use of small crews of men working throughout the field season for several years.

TROPICAL FORESTRY

The great forests of Central and South America, and of both temperate and tropical climates in the Orient, are destined to play an important part in the development of the world's civilization and commerce. It is highly important that wise policies be formulated in the handling of these as yet almost untouched storehouses. It will require the services of an army of trained foresters to execute the policies. In the new worldwide commercial relations which the United States will probably assume, it will be of material advantage if in the United States there could be developed a great central forest school for the foresters of the tropics, the Orient, and South America. The relations which could thereby be built up in the world's timber business would be far raching. The University of California is pre-eminently the place for such a school, because of its geographical location and the climatic conditions to be found in California, which make possible the growing of a wide range of foreign timber species for demonstration purposes.

THE PHYSIOLOGICAL EFFECTS ON PLANTS OF VARYING AMOUNTS OF SODIUM SALTS

One of the most important questions affecting agriculture in the semi-arid sections of California is that of alkali. In fact it may be safely assumed that the accumulation of soluble substances, principally sodium salts, in the soils of the semi-arid west, and the chemical, physical and biological effects produced thereby, touch in a broader way and are among the most fundamentally important of all soil questions appertaining thereto where irrigation is practiced.

It is true that much study has already been devoted to this subject, but still only the surface has been touched and very much yet remains to be determined. It is important to remember that previous studies on the effects of alkali salts have been quite largely confined to cases where large amounts are present, and that the generally accepted views relative to alkali injury refer to the effects of large amounts. There is some reason for suspecting that the so-called physiological diseases may in some rather obscure way be associated with, if not caused by, soluble sodium in soils. A thorough study of these questions would in any event establish the facts. Carefully planned laboratory studies on the chemical, physical and biological effects produced by soluble salts coupled with cultural experiments in which exact studies are made with plants, are the basis for a truly scientific investigation of this subject.

In this connection it is highly desirable to investigate means of counteracting the effects of soluble sodium through organic manures, and the use of other chemical substances. The establishment of a permanent subdrainage experiment, where the conditions can be carefully controlled, will be necessary, and will form an important adjunct to the various irrigation systems.

SCARS AND BLEMISHES ON CITRUS FRUITS

Considerable direct loss through culls or reduction to lower grades is sustained each year through marred fruit. This is probably more pronounced with those Valencias which are not harvested until midsummer or later. The exact responsibility of various insects for some of the fruit markings has not been determined. The plan would be to make a complete collection of all the insects found on citrus trees and to confine all of these that might in any way be responsible, with the fruit at various stages from the beginning to maturity.

THE FRUIT BARK BEETLE

This insect occurs only in the southern part of the state. It has been introduced from the east and was unknown up to three or four years ago. It is already widely spread and doing considerable damage to apricots, peaches, and other deciduous fruit trees. The life history and methods of control have not been determined for this section of the country.

THE SCALE INSECTS OF THE DATE PALM

Two species of scale insects are the most important pests of the date palm. The life history of one has not been determined and further work is demanded on control measures. One man would need to be stationed at Mecca or in the Imperial Valley for one season at least.

Investigations need to be made at the Imperial Valley Experiment Farm, or in the Coachella Valley.

THE RESISTANCE OF CITRUS VARIETIES AND SPECIES TO ALKALI

In view of the common occurrence of alkali in the various citrus regions of California, it becomes highly desirable to determine the degree of tolerance to alkali of the various varieties and species that may be used as stocks, and the variation in tolerance that may exist among different individuals of the same variety or species. If, as will probably be the case, different degrees of tolerance are found, it may be possible to obtain strains that will be much more resistant to the detrimental influence of alkali and justify the use of valuable citrus lands that otherwise may become worthless for this crop. The following would be important stages or factors of the investigation:

(*a*) The testing of the comparative resistance of as many different types and species of citrus as give promise of value as stocks.

(*b*) Variation in degree of resistance of different individuals of the most resistant species.

(*c*) The selection, reproduction and testing of promising resistant variations.

(*d*) The effect of alkali on susceptible non-tolerant varieties grown on resistant stocks in alkali soils.

THE IMPROVEMENT OF THE APRICOT BY BUD SELECTION

With the enthusiasm that has been stimulated by the work of the United States Department of Agriculture on the feasibility of obtaining improved strains by selecting quantitative and qualitative somatic variations in the citrus industry, there has grown up a demand by the planters of so-called "pedigree trees" in the various deciduous fruits. A justification of this demand and the extra expense imposed on the nurserymen, and thereby on the fruit grower himself, still remains to be proved. There is a great deal of controversy over the probability of marked results being obtained in the selection of such variations, and the few investigations carried out by some of the eastern stations have left the problem still unsolved.

With the large amount of capital invested in nurseries and deciduous fruits in the territory, it is evident that the station should be in position to give positive information on this subject. To obtain such information, it is proposed to undertake the work of improving the apricot by bud selection. This will require the selection of orchards of certain standard varieties in which the yield per tree, quality of fruit, etc., is followed carefully for several years to determine whether different bud types exist, after which the transmission of these types in their bud progeny will require to be studied. The apricot is quick to come into bearing, is of great commercial importance, and is thus well fitted for such an investigation.

THE DECAY OF CITRUS FRUIT IN PACKING HOUSES

Much attention has been given the question of careful handling of citrus fruits in relation to various decays. Many positive results have been obtained. Notwithstanding this success, there still occurs far too much decay in fruit, particularly in years like 1914–15, when it becomes necessary to hold fruit (lemons) in storage for a considerable period of time.

Such an investigation should include a very thorough study of the fungi and conditions that cause decay in packing houses and in transit. A number of fungi are known to cause decay, but the factors which govern their optimum activity in causing decay are little understood. Furthermore, there are some troubles apparently non-parasitic, such as the so-called internal decline of lemons, about which growers and packers have been considerably alarmed for the past two years.

During the past summer the Lemon Men's Club has by resolutions urgently requested the investigation of these troubles, and the California Fruit Growers' Exchange has also called attention of the station to the importance of work on these problems.

The study of this subject will require the investigation of the methods of storing and curing fruit and the influence of the following factors on decay.

1. Influence of temperature (*a*) on infection, (*b*) on decay, (*c*) on growth of organisms concerned.
2. Influence of moisture (*a*) on infection, (*b*) on rapidity of decay, (*c*) on sweating process, etc.
3. The effect of methods of handling the fruit in the house, as washing, drying and sterilizing, which methods are known to be defective.
4. The influence of grove conditions and practices on susceptibility of the fruit to infection and decay, such as fertilizers, soil types, mulching versus clean cultivation, bright sunshine versus shade, and degree of maturity of the fruit.

Work has been under way on some phase of this problem and considerable data have been secured, particularly on internal decline of lemons and wash water disinfection. However, it has not been possible to undertake the problem along the lines suggested above, or as its importance demands.

GUM DISEASES AND BARK DISEASES OF CITRUS TREES

Many points have been worked out as to the cause, prevention and control of *Pythiacystis* and *Botrytis gummosis* on citrus. It is very important that a more intensive study of psorosis (scaly bark) of oranges be made, to discover the cause or causes, and factors influencing its occurrence. This disease in many citrus sections of the state is gradually increasing and no very satisfactory remedial or preventive measure exists.

WALNUT BLIGHT

The walnut blight is without doubt the most destructive disease confronting the walnut industry in California. Although the disease has received considerable attention and much has been learned about it, up to the present no preventive or adequate control measure has been discovered. Much loss is caused every year by this malady, and in epidemic years it may almost destroy the crop. The most serious attacks occur in the walnut regions of southern California near the coast, where it seems this crop comes nearest to perfection. It is not an uncommon occurrence to have one-fourth or even one-half of the nuts in a grove affected and rendered unmarketable by this disease.

This is probably due in some measure to an incomplete knowledge of the causal organism and the conditions attending the infection.

Some of the points demanding further investigation and which it is planned to take up are:

1. Methods of infection and dissemination of the causal organism.
2. Different ways in which the organism winters over.
3. Effects of fertilizers, cultivation, soils, etc., on susceptibility to infection.
4. Study of resistant variation. (This is now being thoroughly done.)
5. Methods of control based on above factors.

At present experiments are under way and studies will be continued through the season, but far less energy can be devoted to the work than the situation demands.

BUILDING PROGRAMME FOR THE UNIVERSITY FARM

Bills were introduced into the last legislature for permanent improvements at the University Farm amounting to $170,000. These were for a creamery building and abattoir, the former to include rooms for butter making, cheese making, ice-cream making, testing laboratory, refrigerating plant, and at least three classrooms and necessary offices, the latter to contain rooms for slaughtering, for demonstrations in meat cutting and for refrigeration; a machinery building, to include testing laboratory, drafting room, machinery display shed, classrooms and offices; a building for three classes in livestock judging, and a number of small structures such as corral sheds, stallion barn, quarantine quarters for livestock, building for grain and hay storage, addition to veterinary building, high-pressure fire protection, three cottages for married laborers, ranch house for farm labor, and an isolation ward for students.

Time and the rapid increase in students have only served to emphasize the need of these permanent improvements and to develop others, such as accommodations for instruction in horticulture, barns for nutrition investigations with cattle, drainage in connection with sewage disposal, and wells and pumps for the irrigation system.

It is eminently desirable that the next legislature should be able to meet these urgent needs of the University Farm, but, if it should be found impossible to do so, then some definite building programme covering four to six years should be developed.

All the structures at the University Farm are built in an inexpensive manner, and, as public buildings go, the total cost will not be large. In fact, the character of the buildings thus far constructed has not infrequently been the subject of criticism. There is, however, no necessity for buildings of a monumental character. All that is necessary are simple well constructed buildings adapted to the particular purposes intended.

NEW CREAMERY BUILDING

The present creamery building at the University Farm School has become entirely inadequate for its purposes. Every department of the work suffers from the cramped condition which exists, notwithstanding that remodeling during the last three years has materially increased the floor space. During the past year over 200 students took laboratory work each week, and during the Short Courses a large number of students were in the dairy laboratories for several periods weekly. By dividing classes into as many sections as the schedule and time would permit, it was still necessary to have as many as 53 in some laboratory groups, which is at least twice as many as is desirable for efficient instruction.

The present building is insanitary, difficult to keep in order, and wholly lacking in certain accommodations essential to proper investigation and instruction in dairy manufacturing.

FARM MACHINERY

The economic value of farm products is in the last analysis dependent upon capital and labor. Yet the economic use of power which involves the efficiency of farm tools and machines is largely an unexplored field.

The University Farm, in view of the existing climatic conditions, offers unusual opportunity to study the problems involved in the use of farm machinery. Machinery of all kinds can be used here almost daily throughout the year. The Division of Agricultural Engineering has recently been created, with the hope that the station may eventually develop the most thorough testing laboratory possible for farm implements of all kinds. Extensive buildings and equipment will be required. No station has yet undertaken this work in the extensive fashion which it seems important for this station to do, yet Minnesota has completed a building for agricultural engineering, costing $225,000; Nebraska has a $180,000 building under construction, and Iowa has authorized, in addition to its existing plant, a building to cost $150,000.

INSTRUCTION IN POMOLOGY

There are certain difficulties surrounding instruction in pomology. At the University Farm students are given opportunity to work with materials and to take part in various processes. A class of students may be brought in close contact with investigations in feeding dairy cattle without materially disturbing the results, but it is difficult to take fifty students into an experimental orchard when the peaches are ripe without disturbing the yields on the different plots. To give the most elementary instruction in pruning fruit trees it is desirable that each student prune at least one tree. Many students can judge the same pig, sheep, horse or steer, but a tree can be used only once in a season for instruction in pruning.

This college year 150 students were supposedly given instruction in pruning fruit trees at the University Farm. The total number of trees, planted more than one year ago, is 3000, of which 2000 are being used for experimental purposes, precluding their use for instructing students to prune trees. When different species of fruit are taken into account, this leaves less than one tree of each per student. It seems probable, therefore, that the available lands for fruit raising at the University Farm must eventually be given over to instructional purposes and other areas obtained for the investigations with deciduous fruits, as outlined elsewhere in this report.

The new tract should be located and developed with the idea that in the course of a decade it might develop into a graduate school for the study of deciduous fruits similar to the Graduate School of Tropical Agriculture at Riverside. What must be kept constantly in mind is that investigations with fruits and undergraduate students can not be mixed without disastrous results.

All that is needed at present is an ample tract of land suitable for the purpose, with a limited supply of buildings for superintendent, laborers, livestock and tools.

GREENHOUSES

Notwithstanding the fact that most economic plants can be grown in the open in California, one of the most insistent demands of the various divisions in connection with their investigational work is for more and better organized greenhouse space. For many lines of investigational work this facility is indispensable. There is also much need for greater space for instructional purposes in connection with the course in plant propagation and floriculture. The problems surrounding the production of flowers and vegetables under glass, which is a considerable and growing industry in California, are still untouched by this station.

POULTRY STATIONS

This station receives more inquiries for information concerning the raising of fowls than on any other subject. It is not strange, perhaps, that there is constant agitation for the establishment of poultry experiment stations elsewhere than at the University Farm at Davis. The time may well come when it will be found desirable to have a poultry plant at the Citrus Experiment Station at Riverside. Poultry problems, however, are for the most part not local, but universal. Consequently the interests of the state and of every locality within the state will be best served by first developing the poultry plant at the university to its maximum of efficiency.

To illustrate the problems yet to be solved, and to indicate that it is of no moment where the experiments are conducted, so long as they are conducted effectively and economically, the following may be mentioned:

Incubation.

(*a*) Determining the relative amounts of ventilation and moisture needed in artificial incubation and how best supplied. Undoubtedly the problems of ventilation and moisture are the most serious ones in artificial incubation and the least thoroughly understood.

Brooding.

(*b*) Determining more accurately the need for ventilation in artificial brooding and ways and means for properly securing it in a practical manner. No thoroughly proved brooding system has yet been devised. There is yet to be determined the optimum size or sizes of flocks of chicks to raise artificially most economically and profitably from the time they are put into the brooder until mature. It is yet to be determined whether chicks can be successfully brooded in flocks of 500, 1000, 1500, 2000, or whether flocks of 100 or 200 are better, and how much space under hover and in scratching area should be allowed per chick in brooder at the start and how rapidly they should be thinned out, if at all.

When more thorough scientific work has been done in the fundamental problems of artificial brooding and the results secured rendered commercially usable one step in the raising of more and better chicks into better quality stock will have been made.

Feeding.

(*c*) More information is needed concerning methods of chick feeding and the values of different grains and feeds for different purposes.

Among questions yet to be answered are:

Does feeding bone meal produce a big strong frame but retard the rapidity of growth? If it does, broiler chicks should not be fed bone meal, perhaps.

How are buttermilk and sour skim milk best fed to chicks? What are their relative values as compared to other protein feeds for growing broilers, for layers?

How do the dry and wet mash compare in chick feeding for different purposes?

More information is needed concerning the comparative feeding values of different grains and mill feeds for laying fowls. Barley, for instance, is one of the cheapest grains, but is it as economical to feed to poultry as wheat or corn?

What are the relative values of the dry and wet mash for egg production, fattening and growth? Should both be used? When and how?

What is the true value of a green feed and how do different green and succulent feeds compare?

Housing.

(*d*) How can muslin curtains be treated to prevent rotting and yet not have their air-diffusing qualities spoiled? What is the best way to construct a muslin curtain to have it turn all rain, be convenient to handle, serve as an awning in summer and not shut the sunlight out of house in winter?

Should fowls to be most profitable be kept in large, medium or small pens?

Yarding.

(*e*) What is the optimum amount of yard area per fowl? Will laying flocks do as well in confinement as in limited yards or on free range? How does the yard area per fowl affect productiveness and health of flock? How does double yarding compare with single yarding? Should the yards be permanently in sod or is frequent cultivation better?

Breeding.

(*f*) Is improvement in the egg producing qualities of a flock a case of bookkeeping? How far are such characters as shell texture, color of egg, size of egg and shape of egg inherited and how far are they matters of health, and maturity and size of egg machinery? How valuable are such visible characteristics as comb development, type of body, fineness of bone in indicating the economic value of any fowl as compared with others? Are these valuable selection factors? Or is the egg record of a fowl and its ancestors of far greater value?

Is there any correlation between such visible characters of a fowl and its performance records?

OFFICIAL TESTING OF POULTRY

For many years the various dairy cattle breeders' associations have conducted official tests for milk and butter-fat production by cows of their respective breeds. In order that the records may be beyond question, the associations have entered into agreement with the various agricultural experiment stations to supervise the tests, the several associations guaranteeing the expense of conducting these tests. A demand has arisen for the official testing of the laying qualities of hens. In the nature of the case it is not feasible, as it is in the case of dairy cattle, to send men to supervise such tests at the home farms, but it would appear practicable for the station to receive pens of fowls and conduct such trapnest tests. Similar reasons exist for an official test of hens as in the case of cows. There has been a marked increase in the yield of butter fat in recent years. It is unquestioned that it is due in part to the introduction of the Babcock test and the official testing of dairy cattle. There is reason to believe that the introduction of the trapnest and official testing of the laying qualities of fowls may increase egg production.

The public importance of such a programme would probably justify the state in providing the necessary buildings and equipment to make official testing of fowls feasible; but it would seem that since such testing has a commercial basis, the cost of maintaining the system should be borne by the parties having their fowls tested.

VEGETABLE GROWING

For certain economic reasons well understood in California it has been claimed that the development of vegetable gardening by the college of agriculture either as a subject of research or instruction was inadvisable. This station has never shared this view.

A Division of Olericulture has been established and has been found to appeal strongly to young men who are desirous of making a start in farming. Some information of a scientific and practical character has been obtained and can be found in the station circulars on "The Late Blight of Celery," "Cabbage Growing in California," and "Tomato Growing in California."

As the investigations in this field of agriculture progress, it is becoming more and more evident that the effect of different climatic and soil conditions must be determined. Through co-operation with the State Hospital at Agnews data of a valuable character are being obtained for the bay section. There is throughout the San Joaquin Valley a large interest in growing vegetables, especially as intercrops for young orchards. It may be advisable, therefore, to establish an experimental vegetable garden on the Kearney Estate, to determine the planting calendar and to find suitable varieties of vegetables adapted to San Joaquin Valley conditions.

As the work develops it may be found advisable to establish an experimental vegetable garden at the Citrus Experiment Station at Riverside, or at some other place in southern California. The station would then be able to be of service to vegetable growers throughout the state.

IMPERIAL VALLEY

The Imperial Valley Experiment Farm of 40 acres, located near El Centro, has now been in operation about six years. This tract has been divided into experimental plots upon which a large variety of crops have been grown and culture trials made. A sufficient amount of data has been accumulated to establish to a certain extent a code of rational practice for the climatic and soil conditions involved. A farm adviser will be placed in the valley to bring the results of this station directly to the farmers located there. The unique conditions under which farming operations are conducted in the Imperial Valley and the results already obtained make it desirable to increase the area of this farm to 160 acres, in order that certain problems in crop and animal production can be studied and correlated.

Much work remains to be done in securing better strains of cotton. The Egyptian cotton could be made a valuable crop in Imperial Valley if properly selected for large bolls, better yield and more storm-proof quality. The Durango cotton should be selected for retention of squares and for drought resistance. There is an important work to be done in educating people to select seed on the farm in order to maintain the quality of the cotton produced.

In this valley, as elsewhere, a greater diversification of crops must ensue in time. The best rotations for the valley can only be determined by trials, which, to be trustworthy, will cover at least a decade. This should be done in advance of an urgent need for the knowledge.

FOREST STATIONS

For some years the college of agriculture has been maintaining two forestry tracts, one at Chico and the other at Santa Monica. These tracts appear to have been established either to study some special problem, such as the utilization of eucalyptus lumber, or to satisfy other conditions. In any case, it is now believed that these tracts do not justify the annual maintenance charge required, and the funds which might be obtained by their sale could be advantageously used in a more comprehensive investigation into silvicultural methods in California.

There are needed two forestry tracts or stations, one in the coast region and the other in the Sierra Nevada Mountains. The coast station should include about one hundred acres of redwood forest land, with a house for a resident foreman and a barn and work house. This experiment tract is needed in order to determine by actual trial the various methods of handling redwood forest, and the best way to manage the redwood to secure maximum yield. Such a station would also help greatly in securing data for rate of timber growth. The final result of the establishment of such an experimental station should be to prove that it is practicable and desirable to manage the redwood forest in such a way as to produce an unending supply of timber. If each community in the redwood region will, through some agency (governmental or private), raise continuous crops of redwood it will mean that logging operations, sawmills and wood-using industries of all kinds can then be organized on a permanent basis. The disadvantages of the shifting lumber community with its unattractive existence, quickly followed by desolation, will be a thing of the past, and in its place will come permanent communities of the best type. The fullest prosperity of the northern coast counties can be secured only by developing both agricultural and forest lands on a permanent basis.

The Sierra station should be similarly equipped. Its results would include a determination, by actual tests, of the best methods of getting nature to replant the pine forest of the Sierras after it is harvested, and the best means of caring for that crop while it is growing. The station should also engage immediately in the procuring of definite data showing the full significance of the relation between the Sierra forests and the run-off of water in our streams. Until perfectly definite data for local California conditions are procured on this point it will be impossible to bring the people of the state to a full realization of what is at stake.

Whitaker's Forest, in Tulare County, offers opportunities for the study of the Giant Redwoods.

In order to determine the best species for planting on ranches and foothill lands, three planting areas properly distributed of about one hundred acres each should be available. Neither buildings nor permanent caretakers would be needed. One of these areas should be located in the semi-arid country of southern California, a second in the foothills of the Sierras, and a third in the interior valley section.

Some of the problems involved will require generations rather than years to solve. Notwithstanding the fact that the area of forested land in California is approximately as great as the area of farm land, thus far work in forestry has been chiefly educational, conservational or exploitative, rather than truly investigational.

THE KEARNEY COUNTRY LIFE SCHOOL

Elsewhere it has been stated that serious consideration must be given to the policy of expansion of the college of agriculture in view of the rapid growth in the attendance of students at the University Farm.

A committee of the staff of the Department of Agriculture has given considerable study to the type of school deemed best to develop when the time arrives for the inauguration of a new instructional unit. It has certain unique features made necessary by the increasing number of students who seek training in agriculture without having had farm experience.

The Kearney Ranch lends itself to the development of such a school as perhaps no other place would. A brief summary of this plan is presented herewith.

The plan is to organize the Kearney Ranch into a series of unit farms, the size of the units depending upon the amount of land that sixteen students can operate easily by working half time. It is estimated that the average size of a unit may be 160 acres, thus providing for thirty units, with an aggregate of about 500 students. It is proposed to make the units sufficiently large, since they can be subsequently divided more economically than expanded.

For a part of each school day these students shall come to a central school plant, where, in classrooms and laboratories, such instruction shall be given as is essential to the successful operation of California farms. The attempt will be made to introduce a wide range of possible farm management systems on the units in order to give the students opportunity to study different systems, while obtaining intimate acquaintance with one of them.

On each unit a system of farm accounts will be kept by the seniors, who will have charge of its operations.

On each unit it is proposed to place an instructor, a farmer and his wife, and a cook. The instructor shall have supervision over the farm and the students, and give instructions at the central school plant in his particular specialty. The noon meal will be served at the central school building, two or more cooks going from the various farm units in turn to prepare the meal.

Each farm unit shall have:

(*a*) A farm house, housing sixteen students, with reserve accommodations up to twenty-four.

(*b*) Farm barns and other buildings.

(*c*) Teams necessary for doing the farm work.
(*d*) Dairy cows, sufficient at least to supply the needs of the farm family.
(*e*) Pigs, poultry, and garden, home fruit trees and small fruits.

The farm house shall be developed to create a type of California farm architecture, suitable for use in the interior valleys. The central buildings should be simple in construction and of the same type of architecture as the various farm houses. Plans for the whole group should be prepared in advance and portions thereof constructed as needed.

It is proposed that admission be granted only to those who are at least eighteen years of age, or who have graduated from a high school, as is now the requirement at the University Farm School.

It is planned to equip each farm unit for twenty-four students, and allow natural selection under stress of farm work and the course of study to reduce the number to about sixteen. The course of study shall be for three years, and each year shall be divided into three periods of four months each. Short vacations may be granted at different times to sections of the student body. There shall be normally two hours of instruction in the morning, one hour for luncheon and noon recess, and two hours of instruction in the afternoon, five days each week. Wednesday will be a holiday.

A PROFESSIONAL COURSE IN VETERINARY MEDICINE

The establishment of a professional course in veterinary medicine at the University of California would be of great benefit to the livestock interests of the state. There are twenty-one veterinary colleges in the United States at the present time, one of them being in California. The majority of these are private schools with low entrance requirements, poor equipment and instructors devoting most of their time to other work, while on account of the attractive openings for veterinary graduates the output of these schools is proportionately larger than in any European country. Numerous Californians, most of them former students of this university, in order to obtain a professional veterinary course in a first-grade college, have felt compelled to go to institutions on the Atlantic Coast or Middle Western states.

During the past year the need for better trained veterinarians has been voiced by nearly every agricultural paper in this country. It would appear from these articles that the average graduate of the veterinary colleges of America does not command the confidence of the stockowner. The College of Agriculture of the University of California maintains higher entrance requirements than any veterinary college in the United States, and it would seem that the time has come when a liberal education, embracing the fundamental sciences, is as necessary for success in the practice of veterinary medicine and surgery as for success in any other agricultural specialty or in the professions of law, teaching or human medicine. The results of the work in veterinary science which agricultural experiment stations and other institutions of agricultural and of medical research are obtaining would be more beneficial if there were sufficient scientific veterinary practitioners to apply these discoveries. Moreover, during the past two decades the average individual value of the various species of domesticated animals has tripled. This increase in value should be met by a corresponding increase in the efficiency of the veterinarians of the state.

ACKNOWLEDGMENTS

The programme of the college and station, as set forth in the preceding statements, is not that of the dean and director alone, but represents the composite viewpoint of the various members of the staff. Much that has been included was written by heads of divisions. Often the language has been adopted without material change. It is only by such efficient co-operation that it has been possible to present to you and through you to the public the hopes and aspirations of the Department of Agriculture of the University of California.

Respectfully submitted,

THOMAS F. HUNT.

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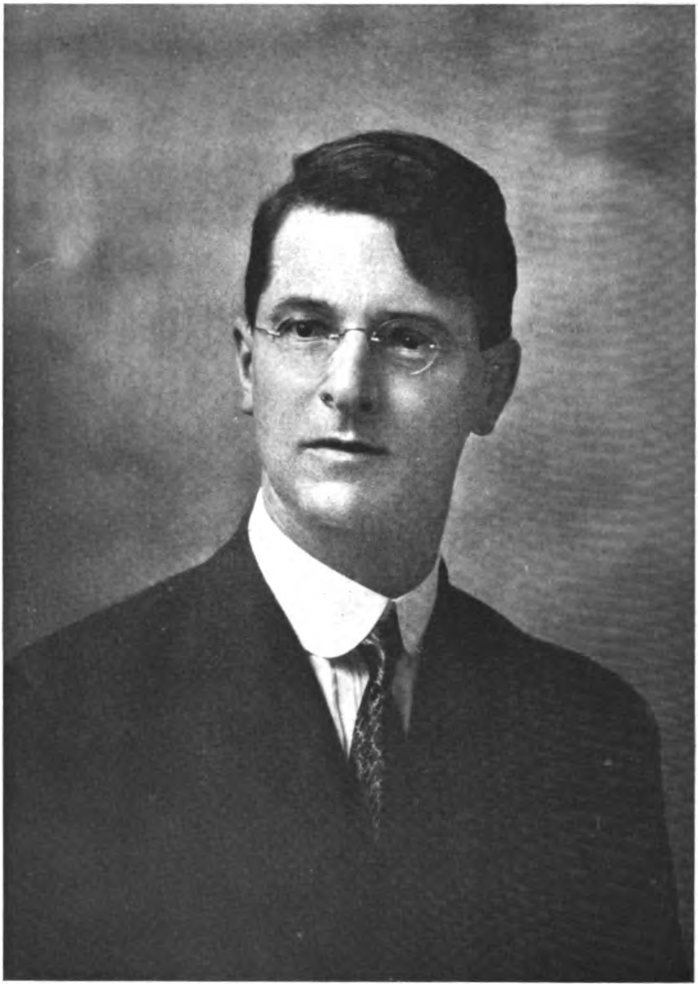

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*H. E. **Billings**, M.S., Assistant in Agricultural Chemistry.

F. T. **Bioletti**, M.S., Professor of Viticulture and Enology.

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Agnes E. **Brown**, A.B., Librarian, Davis.

Donald Bruce, M.F., Assistant Professor of Forestry.

V. C. **Bryant**, M.S., Assistant Professor of Agricultural Extension.

Mrs. D. L. **Bunnell**, Departmental Librarian.

J. S. **Burd**, B.S., Professor of Agricultural Chemistry.

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D. H. **Carey**, Instructor in Floriculture and Superintendent of Greenhouses and Gardens.

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A. W. **Christie**, M.S., Instructor in Agricultural Chemistry.

Lillian D. **Clark**, Instructor in Agricultural Extension.

W. T. **Clarke**, B.S., Professor of Agricultural Extension and Superintendent of Farmers' Institutes.

R. E. **Clausen**, Ph.D., Assistant Professor of Genetics.

J. E. **Coit**, Ph.D., Professor of Citriculture.

G. A. **Coleman**, M.A., Instructor in Entomology and Curator of the Agricultural Museum.

I. J. **Condit**, B.S., Assistant Professor of Citriculture.

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W. V. **Cruess**, B.S., Assistant Professor of Zymology.

J. B. **Davidson**, M.E., Professor of Agricultural Engineering, Davis.

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W. C. **Dean**, B.S., Instructor in Soil Technology.

J. A. **Denny**, Foreman in Cereal Work, Fresno.

S. L. **Denning**, B.S., Instructor in Dairy Husbandry, Davis.

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* Resigned.

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W. H. Dore, B.S., Assistant Chemist in Fertilizer Control.
J. E. Dougherty, B.S., Associate Professor of Poultry Husbandry, Davis.
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H. I. Graser, B.S., Assistant in Agricultural Extension, Nevada County.
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C. M. Haring, D.V.M., Professor of Veterinary Science.
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A. H. Hendrickson, B.S., Assistant Professor of Pomology.
G. W. Hendry, B.S., Assistant Professor of Agronomy, Davis.
W. B. Herms, M.A., Associate Professor of Parasitology.
P. L. Hibbard, B.S., Assistant Professor of Agricultural Chemistry.
Miss C. J. Hill, B.L., Assistant in Dairy Testing.
F. E. Hill, Foreman, Forestry Station, Santa Monica.
D. R. Hoagland, M.S., Assistant Professor of Agricultural Chemistry.
W. T. Horne, B.S., Associate Professor of Plant Pathology.
W. L. Howard, Ph.D., Associate Professor of Pomology, Davis.
W. G. Hummel, M.S., Associate Professor of Agricultural Education.
T. Francis Hunt, B.S., Assistant Professor of Agricultural Extension and Assistant Superintendent of Farmers' Institutes.
R. C. Ingrim, Instructor in Shopwork, Davis.
J. Jacobson, Foreman of Repairs, Davis.
M. E. Jaffa, M.S., Professor of Nutrition.
Miss K. D. Jones, B.S., Assistant in Landscape Gardening.
T. R. Kelley, A.B., Instructor in English and History, Davis.
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P. B. Kennedy, Ph.D., Associate Professor of Agronomy.
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M. A. W. Lee, B.S., Assistant in Agricultural Extension, Alameda County.
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W. E. Lloyd, B.S., Instructor in Poultry Husbandry, Davis.
†R. H. Loughridge, Ph.D., Professor of Agricultural Chemistry, Emeritus.
‡Miss A. M. Lute, A.B., Scientific Assistant, United States Department of Agriculture.
*F. F. Lyons, B.S., Instructor in Agricultural Extension, San Joaquin County.
B. A. Madson, B.S.A., Assistant Professor of Agronomy, Davis.
*L. K. Marshall, Assistant in Agronomy, Kearney Park.
D. E. Martin, B.S., Assistant in Agricultural Extension.
J. C. Martin, B.S., Assistant in Agricultural Chemistry.

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‡ Absent on leave.
* Resigned.
† Died, July 1, 1917.

D. T. Mason, M.S., M.F., Professor of Forestry.
H. A. Mattill, Ph.D., Assistant Professor of Nutrition.
T. C. Mayhew, B.S., Instructor in Agricultural Extension.
Elwood Mead, D.E., Professor of Rural Institutions.
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Woodbridge Metcalf, M.S., Assistant Professor of Forestry.
M. R. Miller, B.S., Assistant Chemist in Insecticide Control.
R. F. Miller, M.S., Assistant Professor of Animal Husbandry, Davis.
J. W. Mills, Instructor in Agricultural Extension, Solano County.
J. N. Moore, Foreman, Forestry Station, Chico.
D. N. Morgan, B.S., Associate Professor of Agriculture and Assistant to the Director.
Walter Mulford, F.E., Professor of Forestry.
J. W. Nelson, B.S., Assistant Professor of Soil Technology.
Carl Nichols, M.S., Instructor in Agricultural Extension.
W. E. Packard, M.S., Assistant Professor of Agricultural Extension.
W. B. Parker, M.S., Assistant Professor of Agricultural Extension, Riverside.
P. T. Petersen, D.V.M., Instructor in Veterinary Science, in charge of serum manufacture.
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S. S. Rogers, B.S., Associate Professor of Olericulture, Davis.
R. P. Royce, B.S., Instructor in Animal Husbandry, Davis.
C. W. Rubel, B.S.A., Assistant Professor of Agricultural Extension.
Richard Schmidt, Orchardist, Davis.
N. P. Searls, Instructor in Agricultural Extension, Yolo County.
H. H. Severin, Ph.D., Instructor in Entomology.
L. T. Sharp, B.S., Assistant Professor of Soil Chemistry and Bacteriology.
C. F. Shaw, B.S., Professor of Soil Technology.
Alfred Smith, M.A., Assistant Professor of Soil Technology.
C. O. Smith, M.S., Instructor in Plant Pathology, Riverside.
Miss E. H. Smith, M.S., Assistant Professor of Plant Pathology.
L. B. Smith, B.S., Instructor in Agricultural Extension.
R. E. Smith, B.S., Professor of Plant Pathology.
‡R. T. Stevens, B.S., Assistant Professor of Landscape Gardening and Floriculture.
G. R. Stewart, B.S., Assistant Professor of Agricultural Chemistry.
J. E. Stiles, B.S., Assistant in Agricultural Extension.
§A. V. Stubenrauch, Professor of Pomology.
A. F. Swain, M.S., Assistant in Entomology, Riverside.
W. L. Sweet, M.S., Instructor in Pomology.
T. Tavernetti, B.S., Assistant Professor of Farm Practice and Assistant to the Dean of University Farm School, Davis.
R. H. Taylor, B.S., Assistant Professor of Pomology.
*C. D. Thomas, Foreman Poultry Division, Davis.
E. E. Thomas, B.S., Assistant Chemist, Riverside.
J. I. Thompson, B.S., Assistant Professor of Animal Husbandry, Davis.
C. M. Titus, M.A., Instructor in Mathematics, Davis.
J. A. Traum, D.V.M., Assistant Professor of Veterinary Science.
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‡ Absent on leave. § Died February 12, 1917. * Resigned.

H. E. Van Norman, B.S., Vice Director of the Agricultural Experiment Station, Dean, University Farm School and Professor of Dairy Management, Davis.
E. C. Voorhies, B.S., Assistant Professor of Animal Husbandry, Davis.
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A. E. Way, Field Assistant in Viticulture, Fresno.
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W. W. Weir, Assistant Professor of Soil Technology.
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C. J. Williams, B.S., Assistant in Agricultural Extension, Sacramento County.
W. W. Wobus, B.S., Assistant in Agricultural Education.
F. W. Woll, Ph.D., Professor of Animal Nutrition, Davis.
C. W. Woodworth, M.S., Professor of Entomology.
H. D. Young, B.S., Assistant in Agricultural Chemistry, Riverside.
*C. J. Zinn, B.S., Assistant in Soil Technology.
J. R. Zion, B.S., Assistant in Viticulture.

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REPORT OF THE DIRECTORS

BERKELEY, CAL., June 30, 1917.

To the President of the University of California:

The annual report of the College of Agriculture last year dealt chiefly with current research activities and results of investigations which the Experiment Station had been unable to undertake either through lack of time, facilities, or funds. This year the report deals chiefly with non-resident instruction, popularly known as extension work. It also includes a statement of some of the activities of the department made necessary by the great movement in which this country is engaged to increase the food supply for our allies.

THE COUNTY FARM BUREAU

The County Farm Bureau organization, which the College has been developing since July 1st, 1913, in co-operation with the U. S. Department of Agriculture, has proved of service in connection with the present great crisis, and has been largely extended through an allotment from the emergency appropriation given by Congress to the Secretary of Agriculture. The College has further supplemented this field of service by the use of a considerable number of the members of the staff who are ordinarily chiefly engaged in research or resident instruction. The willingness with which the members of the staff have adjusted themselves to meet these new conditions and the enthusiasm with which they have entered upon their new work is inspiring. It is rather surprising that a movement which is so far-reaching and which had to be built up without previous experience as a guide and without men trained in the details of the work has gone forward with so few difficulties. It is proposed now after a lapse of four years to discuss some of the broader aspects of the administration of this great movement and certain of the general and local difficulties which have arisen or may be expected to arise from time to time.

FARM ADVISERS

Naturally an important consideration is men. Since the aim of the farm adviser is to make available the researches of the United States Department of Agriculture and of the several experiment stations and allied investigational agencies, a sound scientific, as well as practical training for him is essential. The successful farm adviser must be trained in scientific methods; viz., must be able to weigh evidence accurately, and must be familiar with the actual findings of a fairly considerable body of agricultural investigations. Since it is not humanly possible for any man to keep intimately informed concerning all phases of agricultural knowledge, a prime essential to the success of a farm adviser is association with a large body of specialists to whom he can go for counsel and advice.

It is of course true that in any given county the agricultural practices of the more successful farmers are in advance of the average practice. Hence the first duty of the farm adviser is to study the practices of the successful men, and having carefully analyzed the reasons for their success to bring his knowledge to the less well informed. Here again a training in the scientific method of approach is of great importance. The author of a recent popular novel makes one of his characters speak of the British military officers as having "hearsay minds." This is a common failing of human beings and one which a farm adviser must be trained to avoid.

Valuable as it is, however, it is not enough merely to spread within the county the practices of the more successful farmers. "Water can never rise higher than its source." Progress must finally come to a standstill unless the successful are in some way made more efficient. These considerations have determined the general policy of appointing to the positions of farm advisers men scientifically trained, even though at the beginning they may lack that fund of experience in local practical affairs which is so essential to the highest success.

It was at once evident that the number of suitably trained men was limited. A further policy was adopted of training men for this work. This is done by appointing recent graduates as assistant farm advisers, and requiring two years of field experience before permitting them to act as farm advisers. This plan has been in operation for three years and has worked well.

It has been found that no matter how much training of a scientific or practical character a man may have, nor however successful he may have been in allied fields of work, he needs experience in this particular enterprise before being given charge of a county. In order to meet the present need for men caused by the Federal Emergency appropriation for Farm Bureau work, a plan has been adopted of appointing men of successful experience in agricultural methods as associate farm advisers and giving them some training under a farm adviser before placing them in charge of a county.

From the above discussion, it is obvious that many of the farm advisers are comparatively young men. Of the seventeen farm advisers, eleven registered for military service on June 5th, 1917. The average age of the seventeen men on July 1st, 1917, was 30.7 years. The comparative youthfulness, though a handicap in many ways, is not without its compensation. Only a man of great physical endurance can stand the work that the farm adviser is called upon to do. In addition to working all day, answering inquiries and visiting farms, the farm adviser must attend three night meetings each week on a definite schedule, from which he does not usually return until the middle of the night. For example, during the calendar year 1916 there were held 1886 meetings under the auspices of the Farm Bureaus in fourteen counties. In addition to this the farm advisers addressed 213 other meetings. The total attendance in all such meetings was 99,097, an average of 47.2 persons per meeting. Based upon this work each farm adviser each week visits 13.4 farms, holds 2.5 meetings with an average attendance of 47.2 and travels 286.6 miles.

THE BOARD OF SUPERVISORS

The method of financing of the office of the farm adviser is based on an idea to which public expression was first given by President Taft in an address in Kansas City in which he advocated that each of the two thousand or more agricultural counties of the United States should have an agricultural instructor financed jointly by the federal, state, and county governments. Not only has this method of financing been found to be sound but experience has shown that other methods of financing, such as money appropriated by commercial organizations, chambers of commerce, or associations of farmers, are unsound and sooner or later lead to difficulties of more or less serious character. Too much emphasis can not be placed on the fundamental character of this joint method of financing and upon the type of organization which follows from it. As time progresses and the significance of this unique relationship becomes better understood, it will probably have a marked influence on governmental policies in general.

Under the arrangement now constituted by law the funds for the support of the farm advisers are appropriated (1) by the Congress of the United States, (2) by the state legislature, and (3) by the county supervisors. Neither the Congress of the United States nor the state legislature is charged with the execution of laws, but separate branches of the federal and state governments are created for such purposes. The execution of this particular law is in the hands of the United States Department of Agriculture, representing the Congress of the

United States, and the colleges of agriculture, representing the state legislatures. In the counties there is no legally constituted agency which stands in the same relation to the appropriating agency as does the United States Department of Agriculture to the federal government or the college of agriculture to the state. It has been the policy therefore to look upon the Farm Bureau, although it is not legally so constituted, as standing in the same relation to the interest of the county as the college of agriculture to the state, or that of the United States Department of Agriculture to the federal government.

The general policy concerning the work within a county is worked out with the advice of the directors of the Farm Bureau. The supervisors determine whether it is a movement which they desire to support by an appropriation. If, after trial, the movement does not seem to be valuable, the supervisors may not reappropriate funds at the expiration of their contract, since the appropriation is entirely a voluntary matter. This actually happened in Ventura County. After the farm-bureau system there had been in operation for two and one-half years, the farm adviser was promoted to the position of assistant state leader and a new man assigned to the county as farm adviser. The Board of Supervisors promptly discontinued the work despite a written agreement made by them with the college of agriculture to continue the work for three years. This action may be expected to occur in different counties from time to time. Unless the farmers feel a definite and positive interest in the system after a thorough trial in a given county, it may well be questioned whether it should be continued.

In two instances, one officially, and one unofficially, the college was asked by the supervisors to remove the incumbent and appoint another farm adviser. In the first instance a public hearing was held to determine whether the farm adviser was satisfactory to the Farm Bureau members. The hearing indicated that the farm adviser was eminently satisfactory, and the supervisors not only accepted the verdict of the people but have since made an appropriation for an assistant farm adviser. In other words, the policy is to remove the farm adviser from a county if after a thorough *public* investigation he is found not to be serving the best interests of the county as determined by the farmers themselves.

There are inherent reasons why the legislative or appropriating power should be separate from the appointing and executive power, as is the case in the federal and state governments but which has not heretofore been the case in county governments. For example, the farm adviser, acting under instructions of the federal and state agency, may be advocating cover crops, while a member of the board of supervisors in that county may be a fertilizer agent who feels that his business is not promoted by such advice. A supervisor may be a real estate agent. The farm adviser in the pursuit of his duty may pass adversely on a tract of land so far as it relates to the needs of a particular individual. A Farm Bureau may embark upon some policy such as pooling cream, which is contrary to the business interests of some relative of the supervisor. The board of supervisors may be supporting a chamber of commerce whose interests are not identical with those of the members of the Farm Bureau. All such points of contact are possible elements of friction and misunderstanding.

It is obvious that such conditions cannot be permitted to determine the appointment or continuance of a farm adviser. One of the most important facts concerning a farm adviser is that he represents an agency which does not try to direct or control the actions of any person and whose duty under the law is to discover the truth and disseminate it. It is essential that the farm adviser's position and his promotion shall depend upon the efficiency with which he carries out the purposes of this agency.

THE COUNTY HORTICULTURAL COMMISSIONERS

When the Farm Bureau system was introduced into California there already existed the county horticultural commissioner, who was performing, often with a considerable degree of efficiency, a portion of the work now done by the farm adviser. It is, in fact, to the credit of California that it had, in a measure, anticipated the coming of the farm-adviser system. It had been meeting its own needs in a local way as far as it could for many years before federal legislation instituted the nation-wide movement on a definitely organized basis. The county horticultural commissioner was the pioneer farm adviser, perhaps more accurately the pioneer horticultural adviser, and as such has done excellent service.

The legal duty of the county horticultural commissioner was and is the enforcement of the so-called horticultural laws of the state and the enforcement of the ordinances of the several counties relating to the control of insect pests, fungus diseases, rodents and weeds. Nevertheless, many of the horticultural commissioners have in the past found that they could serve the fruit growers more effectively by giving them advice than by performing police duties only. Indeed, such information often prevented the necessity for any legal action.

Furthermore, in many counties where fruit is not a leading industry there were few occasions for inspection duties or for legal action.[1]

The horticultural commissioner, being employed upon a per-diem basis, found it expedient to employ his time as an adviser. These officers were, and still are, probably of greater service as expert advisers concerning the control of insects, fungus diseases, and related matters, than in the performance of their police duties. Although there have been some notable exceptions, the farm adviser has therefore been looked upon generally as an intruder, for two reasons: first, the county horticultural commissioner, for reasons stated above, felt he had a prior right to perform these functions. Second, the fear, perhaps not without justification in some counties, that his income would be reduced. There are many instances where these two representatives have worked together harmoniously to the manifest advantage of each other and the welfare of the county, as should, of course, be the case.

In some instances, however, the county horticultural commissioners have definitely protested against the farm adviser's giving information concerning horticultural matters. However, the United States Department of Agriculture and the College of Agriculture have no option in this matter. These agencies are specially required by federal law to give information on any subject which their investigations make them competent to furnish. It is obviously in the interests of the public welfare that it should be so. The basic purpose of the farm adviser is to make effective the researches of the United States Department of Agriculture and of the several state experiment stations.

On the other hand, the college of agriculture or agricultural experiment station is not charged by law with the performance of police functions except in certain cases, and cannot therefore perform such duties except in these specified instances. It is quite certain that it is not in the interest of public welfare that it should be charged with any police duties. The execution of the laws of the state is the duty of the executive branch of the state, with the governor as its head, who executes the laws relating to agriculture through such officers as state commissioner of horticulture and the state veterinarian. The functions of the university, and hence of the college of agriculture, are research and education. It cannot be repeated too often that the college does not seek to control the action of any person. Its primary function is to determine the truth and to state it accurately.

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[1] This discussion was submitted to Mr. G. H. Hecke, State Commissioner of Horticulture, who after offering certain suggestions has given it his hearty approval. He says: "The new amendments to the Horticultural Code of California have already taken into consideration the fact that the coming of the farm adviser makes necessary a clearly defined division line between his duties and those of the county horticultural commissioner, and . . . is based upon the acknowledgment of the fact that the farm adviser is serving his county as a representative of a research and educational institution, while the county commissioner will confine his work to the police duties connected with his office and the office of the State Commission of Horticulture. The addition to the California Horticultural Code placing county horticultural commissioners in charge of the control of weeds and rodents, as well as the carrying out of fruit standardization, is a big step toward avoiding future complications between these two county officials. I am sure that the control of weeds and rodents opens up big avenues of activity to the county commissioner, which will give him plenty of work, and will have a tendency to avoid an overlapping of the duties of these two omcials. I have not lost any chance or opportunity of calling the attention of the county commissioners to this fact, and they understand that, while formerly the county horticultural commissioner filled a dual rôle as police officer and as adviser, in the future we expect his duties to be so extensive that, as the farm adviser movement spreads, he will confine himself more and more to police work, as specified in the new amendments to the horticultural code."

Because the legal duties of the county horticultural commissioner were rather inconsequential in some of the less populated counties, the county supervisors have sought to combine the work of the horticultural commissioner with that of the farm adviser and thus save the expense of one of these officers[2]. It would probably not be legal for one man to occupy these two offices, but in such a case he would, as county horticultural commissioner, be responsible to the county board of supervisors, and as farm adviser, he would be responsible to the College of Agriculture of the University of California. It has not been deemed wise to permit such an arrangement.

The reason lies deeper than the obvious administrative difficulties. It lies in the fact that the usefulness of the farm adviser as such would be greatly lessened by putting him in the wrong attitude towards the persons whom he is required to serve. This point of view is a little difficult to comprehend at first because the farm adviser is a new type of employee. He is so novel that there has been great difficulty in finding an appropriate name for him. He is not the agent of the executive branch of the government, but the representative of a research and educational institution. He possesses no executive or legal power, but he serves an organization of farmers known as the County Farm Bureau. Through it he serves all the citizens of the county who are seeking to create wealth out of the soil. He is able to serve them not only through his own knowledge of the science and practice of farming but because he has behind him in the United

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[2] The State Commissioner of Horticulture writes: "The duty of controlling weeds and rodents will make the office of Commissioner of Horticulture of sufficient economic importance to justify a reasonable per-diem salary, even if the county is less populated and perhaps insignificant in the line of horticultural production," and adds: "I entirely share your view as to the inadvisability of having two offices, the one of farm adviser and the other that of county horticulture commissioner, occupied by the same man. It would create serious administrative difficulties."

States Department of Agriculture and in the college of agriculture of his state a body of specialists whose investigations make them competent to give accurate information.

The County Farm Bureau, which is equally as important as the farm adviser, can do many things the farm adviser can not do. The farm adviser does not direct the Farm Bureau, but gives it the benefit of his advice. There is a possibility that the County Farm Bureau might embark upon some plan in which the farm adviser does not concur. However, thus far this has not been found an important practical difficulty.

The maintenance of both the county horticultural commissioner and the farm adviser is doubtless financially difficult for a number of the counties of the state. This fact probably justifies frank discussion of the relations of these two organizations and their future development.

The county supervisors are required by state law to appoint the county horticultural commissioner whenever a petition requesting his appointment is signed by twenty-five or more persons, each of whom is a resident, freeholder, and possessor of an orchard or greenhouse, or nursery, or rice field. The law provides that the compensation of the county horticultural commissioner shall be either not less than eighteen hundred dollars per year, or not less than six dollars per day when he is actually engaged in the performance of his duties. The salary of the deputy horticultural commissioners is five dollars per day, and the salary of inspectors three dollars and fifty cents per day.

The state law under which county supervisors are permitted to co-operate with the United States Department of Agriculture and the College of Agriculture is as follows:

> ''An Act (Laws of 1915, Chapter No. 373, signed May 18, 1915) empowering County Boards of Supervisors to appropriate and use county funds for the support and maintenance of Extension Work in Agriculture and the University of California. The people of the State of California do enact as follows:
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> ''SECTION 1.—The Boards of Supervisors of the respective counties within the State are hereby empowered to appropriate and use county funds in not to exceed the amount of ten thousand dollars for any one year for the support and maintenance within their respective counties of extension work in agriculture under approval of the United States Department of Agriculture and in co-operation with the University of California.''

Before placing the farm adviser in any county it is the policy, although not the law, to require at least one-fifth of the farmers to organize and join a Farm Bureau, to which each member pays one dollar annually to indicate his interest in the enterprise. This money is paid to and spent by the Farm Bureau. The County Farm Bureau is managed by a board of directors—one member from each community in the county and four members elected at large, together with a president, vice-president, and secretary-treasurer. The units of a Farm Bureau are known as Farm Bureau Centers, there being not more than thirteen in any one county. These centers have regular local organization and hold meetings once a month. The farm adviser travels on a regular circuit among these centers, completing the trip once each month.

This organization being completed, representatives of the Farm Bureau request the supervisors to appropriate two thousand dollars annually for three years for the expenses of each farm adviser and one thousand dollars annually for the expenses of each assistant farm adviser permanently located within the county. The college maintains certain other itinerant assistants who go from county to county to take care of the "peak load," to whom it pays all expenses in addition to their salaries. The United States Department of Agriculture and the College of Agriculture of the University of California pay the salaries of all advisers and assistant farm advisers. Speaking generally, a farm adviser is available for each county in California having, in 1910, 500 farms, and a permanent assistant farm adviser for every 1500 farms in addition to the first 1500 farms.

It will thus be seen that in case twenty-five fruit-growers sign a petition requesting it, the county board of supervisors must maintain a county horticultural commissioner, while they may contribute the expenses of the farm adviser in case one-fifth of the farmers in the county have joined the Farm Bureau and paid an annual due of one dollar. The reason for the law requiring supervisors to appoint county horticultural commissioners grows out of the fact that in the absence of suitable authority vested in the State Commissioner of Horticulture, the appointment of a county official is needed to protect a county from the possible introduction of plant pests from other states. In addition to this appointment by the supervisors with salary and expenses, the county commissioner is appointed by the state commissioner to serve the state as quarantine guardian without pay, and in the inspection of incoming plant material from outside the state he is acting directly as his representative. Under the fresh fruit standardization act and the apple standardization act he is also acting under direction of the State Horticultural Commissioner.

The county horticultural commissioner performs three classes of duties:

1. He inspects as quarantine guardian plants shipped to California from other states. Under present regulations such shipments go

directly to their destination and are inspected by the horticultural commissioner or his deputy, often under difficult circumstances. In many cases to make an absolute diagnosis without serious injury to the shipment is well nigh impossible. This could be more efficiently done if the examinations were made at a few points of entry by agents delegated by the State Commissioner of Horticulture. Only a few men would be required for this work. They would soon come to have special expertness for it. It would be possible to provide proper depots so that materials could be inspected without injury and the plants fumigated or otherwise treated as occasion requires. If the proper legal relations existed between the State Commissioner of Horticulture and the county horticultural commissioner, the state commissioner could delegate certain county horticultural commissioners to perform this work.

2. The county horticultural commissioner is now charged with the enforcement of quarantines between counties in accordance with county ordinances. Recent legislation enacted at the request of the State Commissioner of Horticulture happily place the power of quarantining certain counties or districts exclusively within his authority.

3. The county horticultural commissioner is charged with the enforcement of certain state laws, but more particularly with that of county ordinances which the supervisors have adopted.

If the first two of these functions were placed in the hands of the State Commissioner of Horticulture, as the public welfare demands, then the question of whether or not the county should appoint men to enforce the laws and ordinances of local application may well be left to the county boards of supervisors. Without doubt a considerable number of counties in California need the services of such an officer.

Attention should be again called to the tri-party arrangement of the United States, state, and county in the case of the Farm Bureau system. Exactly the same reason exists for such an arrangement with reference to police regulations. The federal government already maintains quarantine officers in this state to inspect plants entering from foreign countries, and there exists a co-operative arrangement between the United States Department of Agriculture and the State Commissioner of Horticulture by which the same officers serve the purpose of both nation and state. The federal laws are sufficient to enable a federal officer to overrule either the work of the state or of the county horticultural commissioner in so far as relates to shipments of plants between states, or between counties. The way to avoid a possible clash as well as duplication of effort is to plan and put into operation a working arrangement between the federal, state, and county officers.

It is the one way to insure the efficiency and permanency of these three sets of officers and incidentally remove all excuses for friction which now occasionally arise between the county horticultural commissioner and the farm adviser.

STUDENT ATTENDANCE

From an industrial point of view this country has been engaged in the war since August, 1914. These new conditions have been reflected in the attendance at the colleges of agriculture in this country. For example, of the 637 students in the College of Agriculture of this University in 1915–16, 108 received degrees. Of the 529 remaining, 176, or 33 per cent, failed to return to college during the first semester of 1916–17. There were 314 farm school students at the University Farm during the year 1915–16, of which 63 graduated, while the 122, or 48 per cent, remaining, failed to return to the school during the first semester of this school year. Whether similar analyses have been made in other colleges is not known, but a study of the entering freshmen in many of the colleges shows that with few exceptions there has been a lessening attendance.

Reference in the last annual report was made to the fact that only 32 per cent of the students of the College of Agriculture came directly from farm homes. There is some reason to believe that the falling off in students has been chiefly from the cities, due on the one hand to greater industrial activities in the cities, which have readily absorbed them, and on the other hand, to the greater interest created thereby in commerce and mining engineering. It is believed that the interest on the part of farm-bred men is on the increase rather than otherwise.

The total enrollment of University students in the College of Agriculture for 1916–17 was 623 as compared with 637 for 1915–16. At the University Farm School it was 314, being the same as for 1915–16. There was greater activity than ever in the Farmers' Short Courses. There were 197 persons registered, compared with 181 in corresponding courses last year. The new course in farm tractors caused an additional enrollment of 53, making a total enrollment of 250 in these short courses.

Thus the total enrollment of residence instruction in agriculture for 1916–17 was 1187, compared with 1132 in 1915–16.

The interest in the correspondence courses in agriculture continues to be well maintained. During the year ending April 30th, 1917, 6248 persons registered for the twenty-five courses in agriculture. Previously 23,374 had registered, making a total registration to date of 29,662. However, 8137 re-enrollments bring the total up to 37,759. During the year 3780 students completed one or more courses.

SPECIAL FORMS OF INSTRUCTION

The College of Agriculture has been developing brief courses of instruction to meet special interests. For example, the last week in December a course for veterinary practitioners was held at the University Farm School, with an attendance of 79 veterinarians. During the first week in January the wool growers had a convention at the University Farm, while in February the Berkshire swine breeders had a meeting and sale. The Citrus Experiment Station held a citrus growers' institute at Riverside in November, with an attendance of over 500. Two poultry short courses, one at Pomona and one at Van Nuys, were held in June, with a total attendance of 470 persons.

The Farm School Picnic, which has grown into a great farmers' field day, occurred this year on April 28th, with an approximate attendance of 14,500 persons. It was more educational than heretofore, and was a credit to the organizing ability and enthusiasm of the students, who are chiefly responsible for its conduct and success.

The College of Agriculture has farm advisers in eighteen counties, in which 218 farm bureau centers are organized, with a membership of about 6000 farmers. Certain allotments of funds from the Secretary of Agriculture will make it possible to extend this system rapidly in the near future.

The boys' agricultural clubs have been organized in more than one hundred high schools, with an average of about ten boys to a club, in which each boy is competing for a prize on the basis of net profit. Every two weeks during the period of this contest each of the boys receives written material for study concerning the crop or animal which he is raising.

As soon as it became evident that the boys' club movement in the high schools was succeeding, the college was strongly urged to extend the movement to the grammar schools. It has now made arrangements with fifteen boards of education by which in each of fifteen high schools an agriculturally trained teacher of agriculture will spend eleven months in the year at his work and will supervise boys' club contests in the grammar schools. Directly or indirectly the College of Agriculture, therefore, is coming in contact with boys between the ages of 10 to 14, with young men between the ages of 15 to 18, and with mature farmers. So far as they attend the college, either at Berkeley or Davis, the college also reaches young men between the ages of 18 and 23.

If all young men who intended to engage in farming came to college for instruction the present system would suffice. They do not, however; neither do they attend the farm bureau meetings, because these meetings are conducted by and are of chief interest to more mature people. The experiment is now proposed of establishing junior farm-bureau meetings composed of young men who are definitely out of public schools but who are not yet ready to take part in the farm-bureau meetings composed of older people. Thus, when this plan comes into full operation there will be a method of reaching all the mature farmers of the state and all boys 10 years of age and over, who desire to engage in agriculture.

This whole problem will be further influenced by the passage of the federal Smith-Hughes Act, one section of which provides money to be used for salaries of teachers in agriculture who shall spend at least one-half of the time in actual instruction on a farm. The administration of that act in the several states is through the state boards of education acting under the approval of a federal board.

BULLETINS AND CIRCULARS

During the year there have been published eleven Bulletins and fourteen Circulars, in addition to the Director's Annual Report, the Prospectus of the College of Agriculture for 1917–19, the Announcement of Courses in Forestry for 1916–17, the Farmers' Short Courses, September 24th to November 2nd, 1917, and fourteen special leaflets on food conservation. Altogether, 1,165,000 copies have been printed, of which approximately 900,000 have been distributed. The mailing list has increased from 31,000 to 35,800 addresses.

BULLETINS

Bul. 270. A Comparison of Annual Cropping, Biennial Cropping, and Green Manures on the Yield of Wheat. B. A. Madson.
Bul. 271. Feeding Dairy Calves in California. F. W. Woll and E. C. Voorhies.
Bul. 272. Commercial Fertilizers. P. L. Hibbard.
Bul. 273. Preliminary Report on Kearney Vineyard Experimental Drain, Fresno County, California. W. W. Weir.
Bul. 274. The Common Honey Bee as an Agent in Prune Pollination. A. H. Hendrickson.
Bul. 275. The Cultivation of Belladonna in California. Albert Schneider.
Bul. 276. The Pomegranate. R. W. Hodgson.
Bul. 277. Sudan Grass. B. A. Madson and P. B. Kennedy.
Bul. 278. Grain Sorghums. B. A. Madson.
Bul. 279. Irrigation of Rice in California. R. D. Robertson.
Bul. 280. The Economic Irrigation of Alfalfa in Sacramento Valley. S. H. Beckett and R. D. Robertson.

CIRCULARS

Cir. 152. Some Observations on the Bulk Handling of Grain for California. B. H. Crocheron and C. J. Williams.
Cir. 153. Announcement of the California State Dairy Cow Competition, 1916–18. F. W. Woll.
Cir. 154. Irrigation Practice in Growing Small Fruits in California. W. A. Hutchins.
Cir. 155. Bovine Tuberculosis. C. M. Haring.
Cir. 156. How to Operate an Incubator. J. E. Dougherty.
Cir. 157. Control of Pear Scab. R. E. Smith.
Cir. 158. Home and Farm Canning. W. V. Cruess.
Cir. 159. Agriculture in the Imperial Valley. A Manual for Settlers. W. E. Packard.
Cir. 160. Lettuce Growing in California. S. S. Rogers.
Cir. 161. Potatoes in California. J. W. Gilmore.
Cir. 162. Bacillary White Diarrhoea or Fatal Septicemia of Chicks and Coccidiosis or Coccidial Enteritis of Chicks. J. R. Beach.
Cir. 163. Some Fundamental Considerations Affecting the Food Supply of the United States. Memorandum Prepared for the Committee on Resources and Food Supply of the State Council of Defense. Thomas Forsyth Hunt.
Cir. 164. Small Fruit Culture in California. A. H. Hendrickson.
Cir. 165. Fundamentals of Sugar Beet Culture under California Conditions. R. L. Adams.

UNNUMBERED LEAFLETS

Observations on the Recent Agricultural Inquiry in California. Thomas Forsyth Hunt.
Canning Fruit in Glass Jars or Wax Top Cans. Frederic T. Bioletti and William V. Cruess.
Canning Fruits without Sugar. Division of Viticulture.
Canning of Fruit and Vegetables. Frederic T. Bioletti and William V. Cruess.
Canning Vegetables in Jars and Wax Top Cans. Frederic T. Bioletti and William V. Cruess.
Drying Winter Vegetables. Division of Viticulture.
Fruit Juices. Frederic T. Bioletti and William V. Cruess.
Jelly Stocks. Frederic T. Bioletti and William V. Cruess.
Living Expenses. M. E. Jaffa.
Preservation of Fresh Eggs. Division of Viticulture.
Preservation of Vegetables by Salt and Fermentation. Division of Viticulture.
Poultry as a Means of Conserving the Food Supply. J. E. Dougherty.
Growing Vegetables under Contract. Stanley S. Rogers.
The Farm Labor Situation in California. R. L. Adams.

NEW PROJECTS

The new projects outlined during the year are as follows:

No. 457. Relation of Oidium to the Keeping Qualities of Shipping Grapes. By F. C. H. Flossfeder reporting to F. T. Bioletti. At University Farm, Davis. Begun August 7. 1916.

No. 458. Orchard Soils Investigations. A Test of Mulches for Orchard Trees. W. L. Howard. Begun August 8, 1916.

No. 459. Orchard Soils Investigations. Effect of Tillage Practices on Soil Moisture Content and Growth of Trees. W. L. Howard. Begun August 8, 1916.

No. 460. Wool Investigations; Growth and Shrinkage of Six and Twelve Months Wool. Robert F. Miller reporting to Gordon H. True. At University Farm, Davis. Begun August 8, 1916.

No. 461. Miscellaneous Projects. W. W. Weir reporting to C. F. Shaw.

No. 462. The Cost of Pork Production when Grain is fed in Conjunction with Alfalfa Pasture. J. I. Thompson and E. C. Voorhies reporting to Gordon H. True. At University Farm, Davis. Begun August 21, 1916.

No. 463. Investigations to determine Causes of Spotted Growth in Barley Fields. C. B. Lipman and J. W. Gilmore. Laboratories in Berkeley. Begun September 14, 1916.

No. 464. Flax Investigations. B. A. Madson reporting to J. W. Gilmore. At University Farm, Davis. Begun September 14, 1916.

No. 465. The Rancher's Home Garden. S. S. Rogers. At University Farm, Davis.

No. 466. Fattening and Marketing Old Ewes. R. F. Miller reporting to G. H. True. At University Farm, Davis. Begun September 23, 1916.

No. 467. Demonstration of Method of Growing Raisin Grapes. S. P. Frissell and A. E. Way reporting to F. T. Bioletti. At Kearney Vineyard. Begun November 7, 1916.

No. 468. Potato Improvement by the Hill Selection and Tuber-unit Method to Determine its Practicability for the Truck Grower. S. S. Rogers and E. B. Babcock. At University Farm, Davis. Begun May 29, 1917.

No. 469. Table Grapes for the San Joaquin Valley. A. E. Way reporting to F. T. Bioletti. At Kearney Vineyard.

No. 470. Pollination Studies. Staff of Division of Pomology reporting to W. L. Howard. At University Farm, Davis, laboratories in Berkeley and orchards of the State. Begun November 24, 1916.

No. 471. Fruit-bud Formation and Development. Staff of the Division of Pomology reporting to W. L. Howard. At University Farm, Davis, laboratories in Berkeley and orchards of the State. Begun November 24, 1916.

No. 472. Studies in Dairy Production by High-Producing Cows. F. W. Woll and Miss Cora J. Hill reporting to G. H. True. At University Farm, Davis. Begun December 6, 1916.

No. 473. Whole vs. Ground Grains as Feeds for Young Dairy Calves. F. W. Woll and E. C. Voorhies reporting to G. H. True. At University Farm, Davis.

No. 474. Investigations of the Efficiency of the "Calf-Way" Milking Machine. F. W. Woll reporting to G. H. True. At University Farm, Davis.

No. 475. Preparation of Volume Tables for Principal California Species. D. Bruce reporting to Walter Mulford. Chiefly in Berkeley.

No. 476. The Development of a Practicable Dendrometer. D. Bruce reporting to Walter Mulford. In Berkeley. Completed.

No. 477. Cover Crop Breeding. L. D. Batchelor reporting to H. J. Webber. At Citrus Experiment Station, Riverside.

No. 478. Miscellaneous Drainage Investigations. W. W. Weir reporting to C. F. Shaw. Portions of State needing drainage.

No. 479. Soil Survey of Santa Maria Area. E. B. Watson (U. S. D. A.) and A. Smith reporting to C. F. Shaw.

No. 480. Reconnaissance Soil Survey of Southern California Area. Portions of Los Angeles, San Bernardino, Riverside, Orange, San Diego Counties. L. C. Holmes (U. S. D. A.) and others reporting to C. F. Shaw.

No. 481. Soil Survey of Ventura Area. J. W. Nelson and others reporting to C. F. Shaw.

No. 482. The Use of Pepsin as a Substitute for Rennet in the Manufacture of California (Granular) and Cheddar Cheese. H. S. Baird reporting to C. L. Roadhouse. Begun December 29, 1916.

No. 483. Is a Given Soil Type in Different and Far Separated Regions of California of the Same Nature in all Respects? Robert Pendleton reporting to C. B. Lipman. At laboratories and greenhouses in Berkeley.

No. 484. To Determine the Relative Value of Milo in Different Forms for Pork Production. J. I. Thompson reporting to G. H. True. At University Farm, Davis.

No. 485. Skim Milk vs. Whey in Pork Production. J. I. Thompson reporting to Gordon H. True. At University Farm, Davis.

No. 486. A Study of the Thermal Death Point of Bacillus botulinus, especially in Relation to the Sterilization of Canned Vegetables. W. V. Cruess in co-operation with the State Board of Health, reporting to F. T. Bioletti.

No. 487. Prune Studies. Staff of Pomology. Begun March, 1917.

No. 488. The Cumulative Effect of Cropping. G. R. Stewart and others reporting to J. S. Burd.

No. 489. A Detailed Study of the Effect of the Barley Plant on the Soil Solution. D. R. Hoagland and G. R. Stewart reporting to J. S. Burd. At Berkeley.

No. 490. Study of the Relation of the Concentration of Nutrient Solutions to the Growth of the Barley Plant in Sand and Water Cultures. The Relation of Solution to Absorption and Forms of Combination of Important Elements. D. R. Hoagland reporting to J. S. Burd.

No. 491. Studies in Soil Moisture. E. E. Thomas reporting to W. P. Kelley. At Whittier, California.

No. 492. The Fruit Bark Beetle. H. J. Quayle, A. F. Swain, reporting to H. J. Quayle, Riverside, California.

No. 493. A Synopsis of the Aphididae of California. A. F. Swain reporting to H. J. Quayle, Riverside, California.

No. 494. Manufacture of Concrete Irrigation Pipe. S. H. Beckett and Roy Wray reporting to Frank Adams. At University Farm, Davis.

No. 495. Studies in Adaptability and rate of Growth of Trees at the Santa Monica Forestry Station. W. Metcalf reporting to W. Mulford. At Santa Monica Forestry Station. Begun March 21, 1917.

No. 496. Studies in Adaptability and Rate of Growth of Trees at the Chico Forestry Station. W. Metcalf reporting to W. Mulford at Chico Forestry Station.

No. 497. Methods and Cost of Distributing Milk with Special Reference to Oakland, Alameda and Berkeley. E. Mead.

No. 498. Survey of Proposed Bishop Drainage District. W. W. Weir reporting to C. F. Shaw.

No. 499. Grape Syrup as a Substitute for Sugar in Canning. Division of Viticulture reporting to F. T. Bioletti. At Berkeley, Davis and various canneries.

No. 500. A Survey of Utilization of Garbage for feeding Swine in California. F. M. Hayes and P. T. Petersen reporting to C. M. Haring.

No. 501. Increasing the Lamb Crop on the Range. G. H. True and R. F. Miller reporting to G. H. True.

No. 502. Investigation to find the Relative Value of Wheat, Hulled Rice and Paddy Rice as Grain Feed and of Wheat Shorts vs. Rice Polish in Mash for Laying Hens. By J. E. Dougherty. At University Farm.

No. 503. Study of Adaptability and Availability of Wood for Treenails. By M. B. Pratt reporting to W. Mulford.

No. 504. Canning and Preserving Fruit Without Sugar. W. V. Cruess reporting to F. T. Bioletti.

No. 505. Economical Drying of Wine and Table Grapes. F. C. H. Flossfeder and A. E. Way reporting to F. T. Bioletti.

No. 506. A Study of the Manufacture of Cheese and Whey. By H. S. Baird. University Farm, Davis.

No. 507. Drying Vegetables. Division of Viticulture reporting to F. T. Bioletti.

No. 508. Home Drying of Fruit. W. V. Cruess and F. C. H. Flossfeder reporting to F. T. Bioletti.

No. 509. Preservation of Vegetables with Salt. By W. V. Cruess reporting to F. T. Bioletti.

No. 510. Entomological Field Work. E. R. DeOng reporting to C. W. Woodworth. At University Farm.

No. 511. Preservative Treatment for Wood Silos. By J. B. Davidson and H. L. Belton reporting to J. B. Davidson. At University Farm, Davis.

No. 512. Reconnaissance Soil Survey of the Upper San Joaquin Valley. By J. W. Nelson and E. C. Eckmann reporting to C. F. Shaw.

There are submitted herewith a series of reports covering the activities of the Division of Agricultural Extension, together with several discussions growing out of the agricultural inquiry made by direction of the Committee on Resources and Food Supply of the State Council of Defense, as follows:

The Field Work of the College of Agriculture. Warren T. Clarke.

General Summary of Farm Adviser and Farm Bureau Work in 1916. B. H. Crocheron.

Agriculture Clubs in California. B. H. Crocheron.

The Agricultural Inquiry. David N. Morgan.

Observations on the Recent Agricultural Inquiry in California. Thomas Forsyth Hunt.

Summary of the Reports of the Field Parties conducting Agricultural Inquiry, April 16–27, 1917.

I. Southern California. L. D. Batchelor.
II. Central Counties. B. H. Crocheron.
III. South Coast Counties. W. T. Clarke.
IV. Inyo County. V. C. Bryant.
V. Eastern Counties. W. L. Howard.
VI. North Coast Counties. T. Francis Hunt.
VII. North Central Counties. H. E. Van Norman.
VIII. Northeastern Counties. G. H. True.
Irrigation Survey. Elwood Mead and Frank Adams.

Ever since the United States was declared to be in a state of war, the department by your instructions has considered it its first duty to serve the federal and state governments in promoting the increased production by field measures. This new activity has necessitated some change of direction and emphasis in the research work of the station.

On April 12, 1917, the members of the staff throughout the state were called into conference. A committee was appointed to classify the projects then in progress into those which should be continued and those which could be temporarily abandoned because of the emergency. Obviously certain projects must be kept going at all cost, since a break in the continuity of the work would be fatal. A committee was also appointed to procure suggestions from the divisions regarding emergency investigations to be undertaken, and to pass upon their relative importance. About a dozen emergency projects were started and eighteen other projects have been passed upon favorably and will be carried on as time and funds permit.

Very truly yours,

THOMAS F. HUNT.

THE FIELD WORK OF THE COLLEGE OF AGRICULTURE

By W. T. Clarke

The work of the Division of Agricultural Extension has included land examinations, field demonstrations, extension schools, farmers' institutes, single lectures, running an agricultural demonstration train, exhibits at fairs and other shows, organization of women's clubs and special home economics demonstrations and lectures, county farm adviser and farm bureau work, and agricultural clubs in the schools.

During the past year the work has grown to such proportions that it has been necessary to put on certain Extension specialists to meet the demand. This demand for special work has come from both the counties that have county farm advisers and from the counties that do not have farm bureau organizations. These specialists have filled a long felt need in doing effective extension work and have been a valuable addition to the Division.

FARMERS' INSTITUTES

Farmers' institutes have been held in the counties which do not have county farm advisers insofar as the farmers have demanded these institutes and petitioned for the same. Twenty one-day institutes have been held in the various unorganized counties of the state and five two-day institutes, with a total attendance of 1843.

Farmers' institutes are not held in the counties where there are county farm advisers, and this, together with the fact that a large number of them have been replaced by field demonstrations and single special lectures, accounts for the fact that the number of institutes this year was not as great as in previous years. The farm advisers took part in 1902 meetings, including 1689 farm bureau meetings, with a total attendance of 94,306 persons.

SPECIAL INSTITUTES

During the past few years there has been a tendency for farmers' institutes to become more specialized, and growing out of this we gave during the past year a few special institutes where only one subject was discussed during the entire time. A notable example of this was the Fig Institute held at Fresno, January 12th and 13th. There was a total of five meetings where nothing was discussed except various phases of the fig industry. This meeting was attended by practically all the fig growers throughout the San Joaquin Valley. The average attendance at each meeting was approximately 350, making a total attendance of about 2000.

SINGLE LECTURES

During the past year there have been given by various members of the staff, under the auspices of this Division, 430 lectures, with a total attendance of 33,938. These are given largely in connection with various clubs, granges, and other local agricultural organizations. Some subject of special and timely interest is usually discussed at these lectures and the audience is also given an opportunity to ask questions along the lines of discussion. In this way they have considerable value in bringing before the people the services of the College of Agriculture and also in imparting specific information along the lines of the subject being discussed.

FIELD DEMONSTRATIONS

Following up the general policy of giving special work which is of timely interest, a great many field demonstrations have been given during the past year. These demonstrations use up from one-half day to a day's time. The usual form of giving demonstrations is for the demonstrator representing the College of Agriculture to give a short discussion in some building such as a school house, or often in the open field, and then proceed to give some special line of demonstration.

Demonstrations were given last year of latest methods of pruning vines, of all ages, pruning of all kinds of deciduous fruits, control of various insect pests and plant diseases, demonstrations of the control of hog cholera, selection of all kinds of live stock, and a great many farm home demonstrations, such as canning, drying of fruits, etc.

The total number of demonstrations during the past year was approximately 69, aggregating a total attendance of 3061.

MOVABLE SCHOOLS

In some localities there has been given during the past year a special Extension School along some special line of farming. These schools last from three to five days, holding from two to three sessions per day. These are modeled somewhat after a farmers' institute, but specialized to the extent of only studying one subject, together with its allied phases. They also consist of a great deal of demonstration work. These schools give the farmer of the locality an opportunity to get acquainted with the instructors and also gives the instructors an opportunity to get acquainted with the farmers' conditions, so that the chances for doing real service and imparting practical information is greater than where a single lecture or a single institute is held.

Owing to a limited number of workers and funds, only two of these schools were given during the past year, with an average daily attendance of 69, aggregating a total of 696.

FAIRS

During the past year various educational exhibits were prepared by the Extension Division showing the results of some of the investigational work of the Experiment Station and the educational work of the College of Agriculture. Five exhibits were prepared for state and county fairs and one permanent exhibit. Excepting the permanent exhibit these exhibits were all accompanied by specialists that presented certain lines of work that would be of special value to that particular locality. Judging the different agricultural exhibits, including livestock, was also a part of the work done at these and other fairs.

DEMONSTRATION TRAIN

During the month of May a special Agricultural Preparedness Train was run through the states of Utah, Nevada, and California, over the Los Angeles and Salt Lake Railroad. This train was a cooperative arrangement between the Utah Agricultural College and the Universities of Nevada and California, and the Los Angeles and Salt Lake Railroad. This station had two cars in the train, *i.e.*, a car of beans and a car of forage crops. The plan for operating this train was to spend one day in each town, keeping the train open each day and holding an evening meeting each evening. The total number of people passing through the train was 55,000. The total attendance at the evening meetings was 2949. This shows that the train was well attended and did very effective work.

LAND EXAMINATIONS

The Extension Division is constantly receiving requests to examine ranches. These requests come from varied sources—from the new settlers who are not familiar with California conditions, city people who want to go on the land, non-resident owners, and persons who desire help to "stop leaks" in ranches in operation. In doing this work the department has adopted the policy of gladly rendering service to anyone who is trying to make wealth from the soil. In order to facilitate the work the problem to be investigated should be presented to the Extension Office either in person, by mail, or by phone, in order that the advisability of examination, and the specialist from the office best adapted to do the particular piece of work in question may be determined. Problems are investigated and opinions given regarding agricultural questions, but valuations are not placed on properties for obvious reasons. Nor are differences arbitrated between buyers and sellers of property.

During the past year the Extension staff have examined a large number of properties, which vary in size from the five-acre suburban tract up to ranches of 5000 acres. The larger number of requests for examination are ranches of from 30 to 160 acres.

Three men on the staff are in a position to do this work, and each of the men has made on an average of from one to four examinations a week. During the last year more than 100,000 acres of land have been examined and reports given thereon. This does not include visits made to sections to investigate diseases, insect pests, and soil problems that may be prevalent in some particular section of the state.

FARM HOME MANAGEMENT PROJECT

Farm Home Lecture-Demonstrations.—The work in California during the fiscal year 1916–1917 has been directed chiefly to lectur-demonstration work in the conservation of farm home products. The records of this work show that 355 lectures and lecture-demonstrations have been given in more than three-fourths of the counties of the state, with a total attendance of 12,708 housekeepers. The records also show that 40 per cent of the lessons have been given on canning; 20 per cent on jelly making; 16 per cent on balanced rations; 11 per cent on salads; 7 per cent on left-overs. The remaining 6 per cent covers a variety of subjects suggested by special needs. Mimeographed copies of the recipes used in the lessons are sent to housekeepers upon request, besides the printed bulletins and circulars available.

The field service deals directly with the problem of living—how to get the most and best out of the products of the farm with the greatest economy of money, material, and labor. Instruction on the subject of conservation of farm products includes canning, preserving, pickling, jelly making, candied fruits, drying fruits, drying and salting vegetables, preserving of eggs, use of left-overs, etc. In canning, the work covers all the meat and poultry, fruit and vegetables produced on the farm. California housekeepers are now conserving for family use, beef, veal, pork, Belgian hare, chicken, turkey, duck, fish, squabs, and in soup, beef, veal, and turtle. To add a variety and increase the supply, combinations are made in the canning. In the fruit work wild and cultivated fruits are combined, giving a more satisfactory product than either used alone.

Extension Clubs for Farm Women.—There are at present 57 women's clubs in California directly in touch with the Extension Division of the College of Agriculture. Twenty-six of these Agricultural Extension Clubs are studying farm home problems by means of regular program study work. The total membership of these clubs is 595 farm women.

The object of these clubs is to study farm home problems; to develop leadership; to study and to use parliamentary law; to promote social life; to create and nourish community activities and civic pride; to form a stable support for Extension service. The main part of the year's program must relate to household subjects. Papers are read at each meeting of the club, followed by some discussion. When the club is not too far distant from Berkeley, six free lectures a year are given. These lectures include the lecture-demonstration work on conservation of farm products, balanced rations, kitchen equipment and kitchen methods, labor-saving devices, and farm sanitation. When these lectures are given an open meeting is held and the entire community is invited by the club. This organized group of workers banded together for mutual helpfulness furnishes a school where country women may receive Extension instruction. It is the connecting link between the country home and the Extension Division.

LETTERS

During the past year the Extension Division has written 28,162 letters, while the total number written by the staff of the College of Agriculture, not including the farm advisers, was 104,000. Most of these have been requests for information regarding some problem that has arisen in connection with some farming operation. For the most part these are inquiries of a specific nature and require a like answer. Two hundred and twenty-three letters were received from prospective settlers from outside of the state, seeking reliable information regarding farming conditions in this state. A great many inquiries were also received each week from people within the state who are considering going farming, seeking information regarding some particular locality or some particular line of farming. The handling of this correspondence, together with making out reports and sending out publications, required the maintenance of a large office force.

GENERAL SUMMARY OF FARM ADVISER AND FARM BUREAU WORK IN 1916

By B. H. Crocheron

Organization.—In the fourteen farm adviser counties of California there are 5312 farmers who are Farm Bureau members and who co-operate with farm advisers in their work. One new county, Imperial, has been successful in completing this organization and securing the $2000 appropriation from the Board of Supervisors during 1916. One other county, San Luis Obispo, has completed its Farm Bureau organization with over the required number of members, but has been unable as yet to secure the necessary appropriation from the supervisors. During the past year, the chief development within the Farm Bureau has been the organization of departments which will undoubtedly prove of great value in that: (*a*) they combine in one organization all persons interested in all phases of agriculture, while at the same time they permit of the joining together of all those interested in one particular phase of agriculture; (*b*) they prevent the formation of other local agricultural organizations which would encroach on the work of the Farm Bureau and might even threaten its existence. Departments have been formed in the Farm Bureau counties of California as shown in the following summary:

Cow-testing departments	2
Cow-testing associations which may become departments	4
Dairyman's department (milk and cream weighing and testing)	1
Cream pooling departments	2
Swine breeders' associations	1
Poultry raisers' department	1
Purchasing and marketing department	1
Farm loan departments (several on way)	1

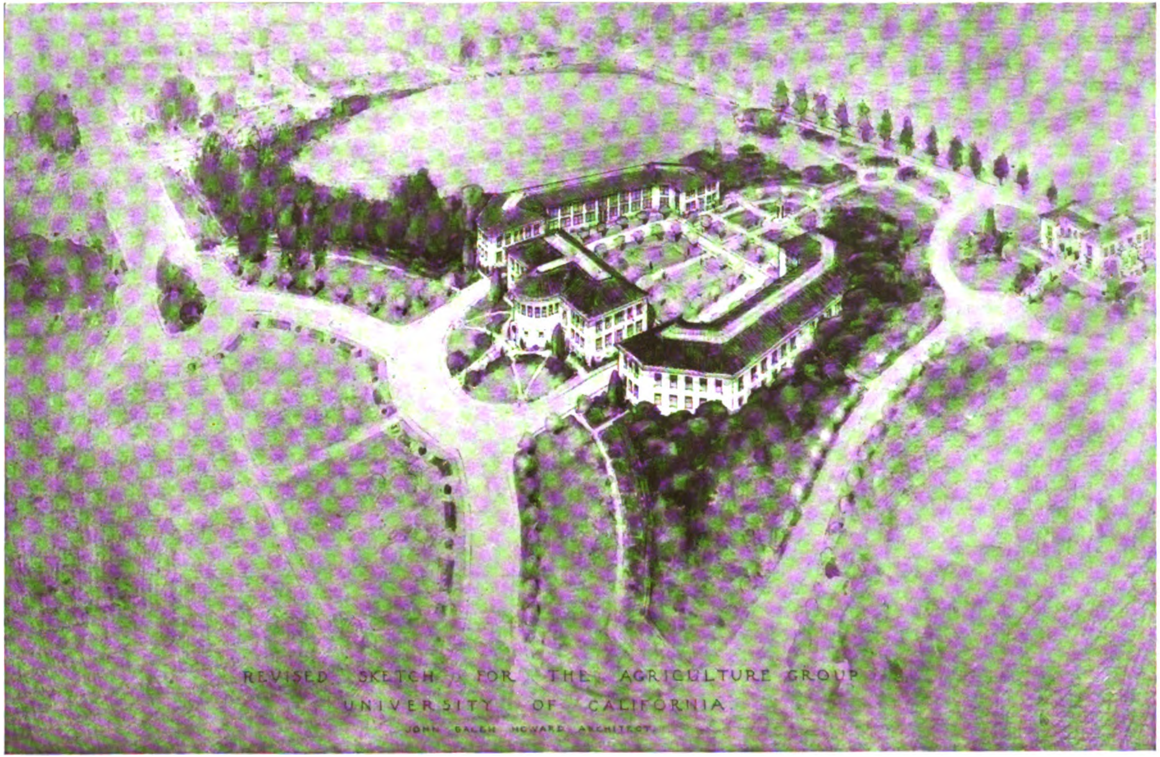
Projects.—The 104 separate projects which the farm advisers have started up to December 1, 1916, may be grouped into the following 13 general classes and 46 sub-classes:

	No. of Counties
I. Rural economics:	
Highway tree planting	2
Telephone service extension	1
Electric power service extension	1
Rural road improvement	1
Control of storm waters	2
Brush burning on hillsides	1
Hill forestation	1
Total number	10
II. Farmers' organizations:	
Hog raisers' and swine breeders' association	3
Dairy, cow-testing and cream-pooling associations	8
Winter vegetable union	1
Lima bean growers' associations	2
Beemen's association	1
Total number	15
III. Boys' agricultural clubs:	
High school agricultural clubs	3
Elementary school agricultural clubs	3
Total number	6
IV. Agricultural fairs	1
V. Home economics	2
VI. Soil treatment:	
Subsoiling	1
Deep plowing	1
Prevention of erosion by terracing	1
Soil drainage	2
Fertilization	13
Liming of soils	4
Alkali reclamation	1
Cover crops	4
Total number	27
VII. Crop rotation	2
VIII. Animal husbandry:	
Dairy improvement	1
Hog cholera control	2
Pig management	1
Total number	4
IX. Forage crops:	
Sorghum	3
Alfalfa culture	2
Winter forage crops	1
Sweet clover	1
Total number	7

	No. of Counties
X. Cereal and field crops:	
Rice	3
Australian wheat varieties	1
Barley culture	1
Bean culture	1
	—
Total number	6
XI. Orchard and vineyard work:	
Pruning	4
Trellising grape vines	2
Tree record work	2
Orchard management	1
	—
Total number	9
XII. Farm pest control:	
Spraying orchards and vineyards for insects and fungus diseases	4
Weed eradication	2
Squirrel and gopher extermination	5
	—
Total number	11
XIII. Farm bureau:	
Legislative committee	1
Increasing attendance at center meetings	1
Assistant farm adviser's work	1
Directors' meeting program	1
	—
Total number	4

Campaigns.—A number of very successful Farm Bureau campaigns for the control of various farm pests, diseases of animals, the improvement of rural conditions, etc., have been conducted during the year. Among these may be mentioned: Control of hog cholera, grasshopper pest, and rice weeds, squirrel destruction, formation of storm districts for the control of flood waters, installation of septic tanks on the farms, improvement of rural schools, and construction and use of silos.

Demonstrations.—Among the demonstrations of special interest are: The use of cover crops in orchards, the growing of Sudan grass, growing alfalfa on hillsides, growing of winter forage crops, the spraying of orchards for insect pests and fungus diseases, the best methods of pruning vines and fruit trees, the use of fertilizers on alfalfa land, the trellis pruning of seedless raisins, varieties of rice adapted to different localities, scientific cooking demonstrations.



REVISED SKETCH FOR THE AGRICULTURE GROUP
UNIVERSITY OF CALIFORNIA
JOHN GALEN HOWARD, ARCHITECT.

Important Lines of Progress.—The most important lines of progress accomplished during 1916 were:

(*a*) The additional employment of assistant farm advisers, thereby relieving the farm advisers of the peak load which, for some seasons, they have been compelled to carry. The plan permits certain individuals to devote their whole time to a single project which needs special attention for its speedy accomplishment. It has also provided a force of young men selected for the purpose a definite training for farm adviser work.

(*b*) The completion of the project system of outlining work to be accomplished and in better office organization whereby this could be followed up.

(*c*) The increased organization of Farm Bureaus through their subsidiary departments, which united many interests under the one banner.

(*d*) Undoubtedly, also, a distinct line of progress has been in the bettering of the farm demonstrations and the distinct increase in their number during the past year. Experience indicates that several years are required before most men can become sufficiently well acquainted with the problems of their county to adequately demonstrate the solution of these to the farmers. It is among the longer established members of the force that the best demonstration work is being done, which leads us to conclude that in sufficient time, we will have it adequately worked out elsewhere.

STATE SUMMARY OF FOURTEEN FARM ADVISER COUNTIES FOR ELEVEN MONTHS

Different farmers visited on their farms	5,142
Total number farm visits made	9,157
Calls on farm adviser at office relating to his work	9,930
Meetings held under auspices of farm bureau	1,689
Total of all meetings in which farm adviser took part	1,902
Total attendance at such meetings	94,306
Membership in county farm bureaus	5,312
Boys' and girls' clubs organized in 1916 in farm adviser counties	40
Total membership in such clubs	437
Agricultural observation parties conducted	54
Total number persons in such parties	1,211
Farmers treating seed oats for smut	24
Acres of oats sown with treated seed	3,140
Farms on which farm adviser knows that alfalfa was sown, following his suggestions	213
Total acres of alfalfa so sown on above farms	1,771
Farms on which farm adviser knows that winter or hairy vetch was grown, following his suggestions	87

Acres of winter or hairy vetch so grown	1,284
Orchards cared for in whole or in part on suggestion of farm adviser	573
Trees in orchards so cared for	309,736
Registered sires (all kinds) purchased	81
Registered cows purchased	78
Cow-testing associations organized	5
Cows tested for milk production through such associations	13,376
Animals tested for tuberculosis by farm adviser or on his suggestion	3,476
Animals vaccinated for blackleg by farm adviser or on his suggestion	4,219
Hogs vaccinated for cholera by farm adviser or on his suggestion	7,372
Silos constructed	94
Crop rotation systems planned and adopted	131
Drainage systems planned and adopted	50
Irrigation systems planned and adopted	30
Acres included in these drainage areas	14,220
Acres included in these irrigation areas	2,640
Farms using chemical fertilizers	56
Tons chemical fertilizer so used	262.75
Tons of lime or limestone used	5,389
Acres of clover and other legumes plowed under for green manure	2,880

AGRICULTURE CLUBS IN CALIFORNIA

By B H. Crocheron

For four years agriculture clubs have been steadily organizing and working in California, until now there are 208 clubs in as many schools, with 2716 school boys and girls growing crops on farms under the direction of the University. The movement for agriculture clubs in California started on its present basis in January, 1914, with the students of the College of Agriculture, who, having an agriculture club of their own, felt that there were boys in the state too young to go to college, or who had missed the opportunity, but who would like to take part in growing contests with crops or animals and so demonstrate their ability to make money on the farm. With the aid and co-operation of the Extension Division, a committee of over forty students launched the campaign for agricultural clubs, which were at that time restricted to pupils of high-school age. The movement was then confined to secondary school boys, because: (1) they were less numerous than the vast army of elementary school boys and thus could be more adequately reached; (2) they were nearly of vocational age and therefore might be expected to respond to the money-making aim of the clubs; (3) they naturally looked up to the college students who were to be their volunteer leaders. From the first these clubs had a rapid growth. All during the long, hot summers hundreds of high-school boys demonstrated their ability and desire to grow crops on California soils.

The fundamental assumptions on which the agriculture clubs started were: (1) that the agricultural institutions of the state and nation had information which, applied to farming, would increase farm profits; (2) that many boys and some girls want to make money by farming and want to be shown how, and (3) that the chances for individual success are increased when several persons in the same neighborhood undertake the same work, an added interest for which comes through competition. Unless the above three assumptions are correct the idea of agriculture clubs in California is unsound.

All boys in any one club grow the same crop, but different clubs must grow different crops because of the highly divergent character of agriculture in the state. Twenty-four possible contests were planned, selection being left to the club on the basis which might be expected to result in the most monetary profit to that particular community. Gradually, through the experience gained, the contests selected have narrowed down to about a half dozen.

In the first year the boy seldom grows a crop of much profit, but by the second year lessons have been learned which, applied in the field, give larger profit. By the third year the boy begins to see that only by unusual care and attention can unusual yields be obtained. Boys then often conduct seed selection or even plant-breeding demonstrations in addition to their regular plot and often extend the area of these plots far beyond the acreage required by the contest until they become large field projects.

No prizes of any kind for club work are offered by the University. It is evident, however, that the work has the enthusiastic approval of the people of the state, since each year they have subscribed large prizes. The chief prize offered has been a trip to the University Farm at Davis. Thus in 1914, 143 boys were there in camp; in 1915 there were 250; and in 1916 almost 300. At Davis the boys camped out for three days in militia tents, were entertained by the college, and spent the time in receiving agricultural instruction. In 1915 the trip also included a visit to the Panama-Pacific Exposition in San Francisco, while in 1916 they journeyed by special train to Berkeley and the campus of the University. For three years the communities have sent a carload of the high-school prize winners of the agricultural clubs on a 9000-mile tour around the continent in order to study the various types of agriculture in America, as well as to see some of the big cities, industries and places of historic interest. The tour is definitely organized for agricultural instruction in order to train leaders for country life in California. Of course, no boy of the contest really ''wins'' or ''earns'' a transcontinental tour. It is an investment made by the people in the expectation that in later years he will give a return to the community far beyond the expenditure. More than anything else, country life needs leaders trained from among their own people. Some of these leaders in the future will come from the ''Transcontinental Tour Boys.''

From the beginning the intention has been to extend the agriculture clubs to the sixth, seventh, and eighth grades of the elementary schools as soon as the high-school development became fixed and as soon as sufficient trained supervision could be obtained. It has been found necessary for the success of agriculture club boys that they should be visited at least once a month on their home farms during the growing season in order to give them the encouragement and advice necessary to make their work a success, also to send them printed instructions and definite information on the crop they are growing at regular intervals of two weeks. While the University could furnish sufficient supervisors to oversee competently the work of the high-school boys, the problem of directing similar work in the elementary schools seemed too broad to be attempted.

But there are in California forty-nine high schools which employ instructors in agriculture, all trained men. Most of these are employed but nine or ten months a year. During the two or three months when farming operations are most active, these instructors are absent from their communities or remain there inactive in leadership. It was finally proposed to employ such instructors for three months in co-operation with the high-school boards. Where this is done the agricultural instructor from the high-school agrees to spend three months in agricultural extension activities in the district tributary to his high-school; the high-school board agrees to appropriate not less than two hundred dollars for expenses; the College of Agriculture, in co-operation with the United States Department of Agriculture, agrees to pay two hundred dollars salary for the work so done. In 1916, fifteen high-schools and their instructors entered into such an agreement. For 1917–18, it is proposed to extend the plan to forty-five such districts.

With the development of the high-school movement, the high-school club members became desirous of organizing elementary school clubs in the country roundabout and exercise volunteer supervision within their territory in the same fashion as earlier the University boys went out among the high schools. Napa County took the initiative in 1916 when boys from the Napa High School were placed in charge of rural elementary clubs conducted under their direction. This volunteer supervision acting under the direction of paid leadership has worked out successfully wherever tried.

The number of clubs organized in the high schools since the beginning of the work is as follows:

1914	343	1916	1157
1915	684	1917	1896

The number of boys enrolled in high-school clubs since the beginning of the work is as follows:

1914	37	1916	103
1915	71	1917	101

To the 1917 figures should be added elementary agricultural club enrollment of 820 boys in 107 clubs in the 15 high-school districts, making 2716 who in·1917 are growing crops in agricultural clubs.

No such system of agricultural clubs has been devised by any other state. While the number of secondary school boys enrolled has been comparatively small, the plan has been so sound that a greater proportion of the boys complete the contests than elsewhere. In 1915, 82 per cent of the boys who enrolled in the contests successfully completed them and passed in reports of their work, while in 1916, 57 per cent so finished. The 1917 crop season is still in full swing, but it is evident that the principle involved will again demonstrate its value. This has been partly due to the close supervision which the agricultural clubs throughout California are given by the men employed for the purpose and to the enthusiasm and help of the students in the higher institution. We may confidently expect the extension of the scheme whereby, under the guise of clubs, California boys raise real crops on real farms.

THE AGRICULTURAL INQUIRY

MADE BY DIRECTION OF THE COMMITTEE ON RESOURCES AND FOOD SUPPLY OF THE STATE COUNCIL OF DEFENSE

By David N. Morgan

At the first meeting of the State Council of Defense, held in Sacramento April 6th, 1917, a Committee on Resources and Food Supply was formed, with the following members:

Charles H. Bentley, San Francisco.
B. B. Meek, Oroville.
Miss Ethel Moore, Oakland.
John A. O'Connell, San Francisco.
Pres. Benj. Ide Wheeler, Chairman.

On April 10th, this committee held its first meeting in California Hall, University of California. Besides the members of the committee, there were present by invitation:

E. T. Ford, of W. R. Grace & Co., San Francisco.
S. P. Frisselle, Superintendent Kearney Ranch, Fresno.
G. H. Hecke, State Horticultural Commissioner.
Victor Henderson, Secretary Board of Regents and Secretary of the Committee.
Jas. Irvine, representing California Development Board.
Stoddard Jess, First National Bank, Los Angeles, Cal.
Dr. Chas. C. Keane, State Veterinarian, Sacramento.
H. S. Maddox, Secretary State Horticultural Commission.
S. B. McNear, Vice-President Sperry Flour Co.
J. M. Perry, President State Agricultural Society, Stockton.
G. H. Powell, Manager California Fruit Growers' Exchange, Los Angeles.
C. E. Rachford, U. S. Forest Service, San Francisco.
Dr. W. A. Sawyer, Secretary State Board of Health, Sacramento.
D. D. Waynick, representing Graduate Students, College of Agriculture.
Thomas Forsyth Hunt, Dean of the College of Agriculture.

And the following members of the faculty of the College of Agriculture:

Professors: W. T. Clarke, B. H. Crocheron, J. W. Gilmore, C. M. Haring, M. E. Jaffa, C. B. Lipman, E. Mead, D. N. Morgan, W. Mulford, W. E. Packard, C. F. Shaw, G. H. True, H. E. Van Norman, R. S. Vaile, H. J. Webber, and C. W. Woodworth.

On motion of John A. O'Connell, it was voted to refer to the College of Agriculture the following topics for consideration:

1. Investigation of the normal requirements of the people of the state for food and the sources of supply.
2. The normal surplus of staples.
3. The facilities for holding reserves.
4. An estimate of the current crop.
5. Animal and sea foods.
6. Possible substitutes for food usually imported.
7. Conservation of food and elimination of waste.
8. The advisability of land-settlement legislation.

In securing these data the College of Agriculture was requested to co-operate with "The State Statistician, the State Horticultural Commission, State Market Director, and such other state, federal, and other agencies as Dean Hunt may find available." The U. S. Forest Service, the State Commission of Horticulture, the State Board of Health, State Veterinarian, State Market Director, the Sacramento Valley Development Board, and the California Fruit-Growers' Exchange were among the agencies that assisted in this work.

The Governor of California also issued the following proclamation, in which he asked the co-operation of all the citizens of the state:

> *Whereas,* an emergency in our National and State affairs now exists in which it is desirable to have full information concerning the production, distribution and supply of food in the State of California; and
>
> *Whereas,* the committee on resources and food supply of the State Council of Defense has directed the Department of Agriculture of the University of California, assisted by the State Department of Agriculture, State Department of Horticulture, Health, Veterinary, State Market Director, the United States Forestry Service and other agencies, to hold meetings in the various counties of the State, and to the end that the desired information may be expeditiously obtained.
>
> *Therefore,* I, WILLIAM D. STEPHENS, Governor of California, do direct that such hearings be held and I call upon the producers and distributers of foodstuffs to set aside their usual occupations in order to attend the conferences at the places and dates between April 16th and 23rd already announced in the various counties.

In accordance with these instructions, eight parties were organized, with the personnel shown on page 45, which, between April 16th and 27th, held hearings in fifty-five counties in California. As the data were collected by the field parties they were mailed to the College of Agriculture, where they were tabulated and digested by a committee consisting of Professors John W. Gilmore, Elwood Mead, and the writer. Each field party prepared a special report on its particular district, which will be found on pages 72 to 95.

On May 22nd, the Dean of the College of Agriculture made a report to the Committee on Resources and Food Supply on the broader aspects of the inquiry, which was ordered printed under the title, "Some Observations on the Recent Agricultural Inquiry in California," (p. 50).

As stated above, hearings were held in every county in this state except three. The members of the staff of the College of Agriculture conducted these hearings, being ably assisted by the State Commissioner of Horticulture and representatives of his office, and the offices of the State Veterinarian, State Board of Health, and the United States Forest Service.

Some federal or state officer in each county was charged with the responsibility of arranging for the meetings. In counties where farm advisers are employed, the farm advisers, with the assistance of their farm bureaus, made the necessary arrangements. In other agricultural counties the horticultural commissioners handled the arrangements in a gratifying manner. In the mountain counties the United States Forest supervisors ably performed this service.

The newspapers, telephone companies and theatres all co-operated in advertising the meetings. The plan called for a forenoon meeting of twelve farmers representative of the various districts of the county. These farmers met in a round-table conference, giving information to the visiting investigators. The subject matter for discussion at the afternoon meeting was decided upon.

There follows herewith answers given at these morning conferences to the twenty-two questions asked:

1. Crops: Per cent of normal acreage:

(*a*) *Alfalfa:*

Normal in Amador, Butte, Contra Costa, Eldorado, Lake, Los Angeles, Mono, Placer, Santa Cruz, Shasta, Sutter, Tuloumne, Yolo, and Yuba. Alameda, 110 per cent; Calaveras, 65; Colusa, 115; Fresno, 80; Glenn, 120; Imperial, 135; Inyo, 105; Kern, 75; Kings, 80; Lassen, 95; Madera, 80; Merced, 75; Modoc, 90; Monterey, 90; Nevada, 110; Riverside, 95; Sacramento, 85; San Bernardino, 80; San Diego, 108; San Joaquin, 90; Santa Clara, 85; Siskiyou, 105; Solano, 120; Stanislaus, 60; San Bernardino, 125; San Diego, 150.

(*b*) *Barley:*

Normal in Amador, Butte, Colusa, Eldorado, Imperial, Inyo, Kern, Modoc, Nevada, Plumas, San Joaquin, Shasta, Solano, Trinity. Alameda, 30 per cent; Calaveras, 95; Contra Costa, 30; Fresno, 25; Glenn, 130; Kings, 55; Lassen, 110; Madera, 48; Mariposa, 70; Mendocino, 110; Merced, 50; Monterey, 85; Orange, 65; Placer, 75; Sacramento, 115;

San Luis Obispo, 105; Santa Clara, 50; Siskiyou, 103; Stanislaus, 90; Sutter, 115; Tehama, 110; Tulare, 35; Tuolumne, 50; Yolo, 125; Yuba, 115.

(*c*) *Oats:*

Normal in Amador, Butte, Fresno, Glenn, Inyo, Kern, Lassen, Modoc, Plumas, Shasta, Solano, Tehama, Trinity, Tuolumne, and Yuba. Calaveras, 85 per cent; Eldorado, 90; Imperial, 60; Los Angeles, 75; Madera, 48; Mariposa, 60; Merced, 85; Monterey, 110; Riverside, 50; San Bernardino, 125; San Diego, 150; San Joaquin, 80; Santa Clara, 50; Siskiyou, 110; Stanislaus, 80; Sutter, 90.

(*d*) *Wheat:*

Normal in Amador, Butte, Colusa, Imperial, Kern, Nevada, Plumas, Sacramento, Solano, Tuolumne, Yuba. Calaveras, 90 per cent; Eldorado, 50; Fresno, 20; Glenn, 120; Inyo, 120; Kings, 25; Lassen, 105; Los Angeles, 75; Madera, 48; Mariposa, 75; Modoc, 120; Monterey, 90; Placer, 90; Riverside, 50; San Bernardino, 125; San Diego, 150; San Joaquin, 120; San Luis Obispo, 115; Santa Clara, 50; Shasta, 110; Siskiyou, 105; Stanislaus, 120; Sutter, 80; Tehama, 80; Trinity, 105; Yolo, 75.

(*e*) *Rice:*

Butte, 110 per cent; Colusa, 136; Glenn, 190; Madera, 800; Fresno, 130; Sutter, 25; Yolo, 144; Yuba, 600.

(*f*) *Sugar beets:*

Normal in Kings, Monterey, Orange, San Diego, San Luis Obispo, Santa Barbara. Alameda, 130 per cent; Los Angeles, 110; Marin, 50; San Bernardino, 50; San Jose, 85; Santa Cruz, 60; Stanislaus, 90; Sutter, 400; Tulare, 95; Ventura, 102; Yolo, 233; Yuba, 400.

(*g*) *Truck crops:*

Normal in Calaveras, Contra Costa, Fresno, San Luis Obispo, San Mateo, and Santa Clara. Alameda, 150 per cent; Imperial, 118; San Diego, 140.

2. Are there poor stands of grain to be plowed under?

Ans. No, in all counties except Calaveras, Kings, Modoc, Sacramento, San Joaquin, Solano, and Tulare.

3. Would silos increase livestock carrying capacity?

Ans. Yes, in all counties, except Orange and Santa Barbara.

4. Are materials available for building silos?

Ans. Yes, in all counties except Imperial and Inyo.

5. How many acres of young irrigated orchards?

Calaveras, 125 acres; Colusa, 3000; Contra Costa, 500; Del Norte, none; Eldorado, 2500; Fresno, 20,000; Glenn, 3500; Inyo, 1200; Kern, 4000;

Kings, 7000; Lassen, 200; Los Angeles, 25,000; Madera, 3000; Mariposa, 20; Merced, 2000; Modoc, 35; Mono, none; Monterey, 2000; Nevada, 300; Placer, 3000; Riverside, 18,000; Sacramento, 5000; San Benito, 4600; San Bernardino, 23,000; San Diego, 2500; San Joaquin, 2000; San Luis Obispo, 100; Santa Clara, 4000; Santa Cruz, 1000; Shasta, 1000; Siskiyou, none; Solano, 300; Stanislaus, 2000; Sutter, 42; Tehama, 1000; Tulare, 500; Ventura, 5850; Tuolumne, 330; Yolo, 500; Yuba, 2000.

6. How many acres of young unirrigated orchards?

Calaveras, 250 acres; Colusa, 5000; Contra Costa, 2000; Eldorado, 1000; Glenn, 200; Humboldt, 500; Lake, 1000; Marin, 200; Merced, none; Mono, none; Monterey, 1100; Napa, 2500; Nevada, 1000; Riverside, none; San Bernardino, 1200; San Diego, 500; San Joaquin, 1000; San Luis Obispo, 11,000; Santa Clara, 4000; Santa Cruz, 1000; Shasta, 300; Siskiyou, none; Solano, 1000; Stanislaus, none; Sutter, 700; Tehama, 500; Yolo, 500; Yuba, 3000.

7. Can irrigated areas be increased?

Ans. Yes, in all counties but Alameda, Fresno, Lake, Modoc, Mono, Plumas, Solano, Trinity, Tulare, Yolo.

8. Is there sufficient labor for present needs?

Ans. Yes, in Alameda, Calaveras, Contra Costa, Fresno, Kern, Los Angeles, Madera, Mariposa, Mendocino, Merced, Nevada, Orange, Placer, San Benito, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Siskiyou, Stanislaus, Tehama, Trinity, Tulare. Answer no, in all other counties.

9. Number of men required for increased crops?

Butte, 5000; Calaveras, 300; Colusa, 5000; Contra Costa, 6000; Del Norte, 75; Eldorado, 500; Fresno, 500; Glenn, 1500; Humboldt, 225; Imperial, 7500; Inyo, 150; Kern, 3000; Kings, 2500; Lake, 300; Lassen, 14; Los Angeles, 750; Marin, 200; Mendocino, 2500; Merced, 500; Modoc, 500; Mono, 50; Napa, 1000; Nevada, 100; Orange, 700; Placer, 500; Plumas, 700; Sacramento, 10,000; San Bernardino, 1000; San Diego, 1000; San Joaquin, 3000; San Mateo, 2000; Santa Cruz, 300; Siskiyou, 500; Sutter, 1000; Tulare, 5000; Ventura, 4300; Yuba, 750.

11. Is there sufficient local money for financing farmers?

Ans. No, in all counties except Calaveras, Contra Costa, Fresno, Glenn, Merced, Nevada, Sacramento, Stanislaus, and Sutter.

12. Do owners of additional land have capital to crop it?

Ans. Yes, in all counties except Calaveras, Eldorado, Glenn, Imperial, Inyo, Kings, Lassen, Madera, Mariposa, Modoc, Nevada, Sacramento, Santa Cruz, Shasta, Siskiyou, and Stanislaus.

13. Is straw burned.

Ans. Yes, in Alameda, Butte, Colusa, Contra Costa, Eldorado, Glenn, Imperial, Kings, Madera, Modoc, Monterey, Sacramento, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Siskiyou, Stanislaus, Tehama, Tulare, Yuba. Answer no, in all other counties.

14. Is manure conserved?

Ans. Yes, in practically all counties.

15. How do carrying capacities of pastures compare with normal?

Contra Costa, 25 per cent; Kings, 30; Kern, Merced, Nevada, San Joaquin, and Stanislaus, 40; Colusa, Fresno, Lake, Monterey, Napa, Orange, Placer, San Mateo, Santa Clara, Santa Cruz, Shasta, Siskiyou, Sonoma, Tulare, Yolo, Yuba, 50; Butte, Eldorado, Marin, Mariposa, Sacramento, San Joaquin, Sutter, Tuolumne, 60; Amador, Calaveras, Imperial, Mariposa, San Benito, Solano, Trinity, 70; Inyo, Santa Barbara, Ventura, 80; Los Angeles, San Bernardino, 90; Del Norte, Humboldt, Modoc, Plumas, normal.

16. Number of acres of new land which can be profitably plowed for summer fallow?

Alameda, 7500; Amador, 10,000; Butte, 20,000; Calaveras, 250; Fresno, 500,000; Glenn, 20,000; Humboldt, 20; Kings, 50,000; Lassen, 8500; Los Angeles, 4000; Mariposa, 11,000; Modoc, 5000; Monterey, 40,000; Placer, 40,000; Riverside, 30,000; San Bernardino, 5000; Siskiyou, 25,000; Yuba, 5000. All the other counties answered ''none.''

17. Condition of livestock?

Normal in Alameda, Calaveras, Colusa, Eldorado, Los Angeles, Marin, Madera, Mariposa, Merced, Mono, Orange, Sacramento, San Benito, San Francisco, San Mateo, Santa Barbara, Santa Cruz, Tehama, Tuolumne, Ventura. All the other counties reported condition of livestock to be below normal.

18. Can number of poultry and rabbits be increased?

Ans. Yes, in all counties but Alpine and Trinity, provided increased feed is produced.

19. Can better use of garbage be made by feeding to hogs?

Ans. Yes, in Alameda, Amador, Calaveras, Contra Costa, Glenn, Los Angeles, Placer, San Diego, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, Stanislaus, Tehama, and Yolo. All the other counties answered ''No.''

20. To what extent are local demands for vegetables supplied?

Entirely in Alameda, Los Angeles, Madera, Orange, San Benito, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Siskiyou and Trinity. In other counties the following percentages of total need only are produced: Calaveras, 45; Colusa, 75; Del Norte, 40; Glenn, 10; Imperial, 80; Kern, 60; Kings, 50; Lassen, 35; Marin, 50; Mariposa, 75; Mono, 50; Monterey, 50; Nevada, 20; Placer, 5; Plumas, 60; San Bernardino, 25; San Diego, 85; Santa Barbara, 50; Santa Cruz, 75; Shasta, 10; Solano, 50; Sonoma, 85; Stanislaus, 50; Sutter, 10; Tehama, 75; Tulare, 50; Ventura, 60; Tuolumne, 50; Yolo, 10; Yuba, 10.

21. Can supply of vegetables be increased?

All counties answered "Yes."

22. Do school vacations come at proper period?

Ans. Yes, in Alameda, Amador, Calaveras, Del Norte, Glenn, Humboldt, Inyo, Kern, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Plumas, San Diego, San Mateo, Santa Clara, Santa Cruz, Shasta, Siskiyou, Sonoma, Sutter, Tehama, Trinity, Tuolumne, Yolo, and Yuba. The other counties answered "No."

At 2 P.M. of each day a public mass-meeting was held and speakers presented to the communities the fundamental considerations of the food supply problem in California. Specific recommendations were given for increasing the forage and other crops in each county.

Reports from all the counties visited indicate that the sentiment aroused at these meetings resulted in an increased cropping of land to sorghums and beans. The important rôle the farmer is to play in this war was presented in a way that caused every farmer attending the meetings to feel a sense of personal responsibility to his government. The benefits of such a feeling cannot be measured.

The following table shows the field parties visiting each county and the person or persons who organized the meeting within the county:

County	Hearings conducted by	Meetings arranged by
Alameda	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	M. A. W. Lee, County Farm Adviser
Amador	W. L. Howard W. T. Pope L. S. Smith	E. T. Katok, Forest Supervisor
Butte	H. E. Van Norman C. B. Lipman G. W. Hendry	Earl Mills, Horticultural Commissioner
Calaveras	W. L. Howard W. T. Pope L. S. Smith	R. W. Ayers, Forest Supervisor
Colusa	H. E. Van Norman C. B. Lipman G. W. Hendry	L. R. Boedefeld, Horticultural Commissioner

County	Hearings conducted by	Meetings arranged by
Contra Costa	W. T. Clarke Geo. Robertson B. A. Madson J. W. Nelson	F. T. Swett, Horticultural Commissioner
Del Norte	T. Francis Hunt C. W. Rubel	E. D. Doxsee, District Club Leader
El Dorado	H. E. Van Norman C. B. Lipman G. W. Hendry	J. E. Hassler, Horticultural Commissioner
Fresno	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	F. P. Roullard, Horticultural Commissioner
Glenn	H. E. Van Norman C. B. Lipman G. W. Hendry	W. H. Heileman, County Farm Adviser
Humboldt	T. Francis Hunt C. W. Rubel H. S. Maddox	A. H. Christiansen, County Farm Adviser
Imperial	H. J. Webber	Paul Dougherty, County Farm Adviser
Inyo	V. C. Bryant	E. M. Nordyke, Horticultural Commissioner
Kings	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	Fred K. Howard, Horticultural Commissioner
Kern	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	G. C. Kreutzer, County Farm Adviser
Lake	T. Francis Hunt C. W. Rubel	F. G. Stokes, Horticultural Commissioner
Lassen	G. H. True R. F. Miller	A. H. Taylor, Horticultural Commissioner
Los Angeles	H. J. Webber R. S. Vaile L. D. Batchelor A. D. Shamel W. B. Rowland	William Wood, Horticultural Commissioner
Marin	T. Francis Hunt C. W. Rubel G. H. Hecke	T. P. Redmayne, Horticultural Commissioner
Mariposa	W. L. Howard W. T. Pope L. S. Smith	L. A. Benedict, Forest Supervisor

County	Hearings conducted by	Meetings arranged by
Modoc	G. H. True R. F. Miller	W. G. Durbin, Forest Supervisor
Monterey	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	E. K. Abbott, Horticultural Commissioner
Madera	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	T. C. Mayhew, County Farm Adviser
Mendocino	T. Francis Hunt C. W. Rubel	C. Van Dyke, Horticultural Commissioner
Merced	B. H. Crocheron C. F. Snaw E. C. Voorhies S. P. Frissell	A. E. Beers, Horticultural Commissioner
Napa	T. Francis Hunt C. W. Rubel G. H. Hecke	H. J. Baade, County Farm Adviser
Nevada	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	D. F. Norton, Horticultural Commissioner
Orange	H. J. Webber R. S. Vaile L. D. Batchelor A. D. Shamel W. B. Rowland	Roy Bishop, Horticultural Commissioner
Placer	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	E. O. Amundsen, County Farm Adviser
Plumas	G. H. True R. F. Miller	D. N. Rogers, Forest Supervisor
Riverside	H. J. Webber R. S. Vaile L. D. Batchelor A. D. Shamel W. B. Rowland	H. J. Webber
Sacramento	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	Carl Williams, County Farm Adviser
San Benito	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	L. H. Day, Horticultural Commissioner

County	Hearings conducted by	Meetings arranged by
San Bernardino	H. J. Webber R. S. Vaile L. D. Batchelor A. D. Shamel W. B. Rowland	J. P. Coy, Horticultural Commissioner
San Diego	H. J. Webber	H. A. Weinland, County Farm Adviser
San Francisco	W. T. Clarke B. A. Madson J. W. Nelson	Dudley Moulton, Horticultural Commissioner
San Joaquin	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	R. D. Robertson, County Farm Adviser
San Luis Obispo	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	S. F. Christierson, Horticultural Commissioner
San Mateo	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	Newton Peck, Horticultural Commissioner
Santa Clara	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	Earl L. Morris, Horticultural Commissioner
Santa Barbara	H. J. Webber	C. W. Beers, Horticultural Commissioner
Santa Cruz	W. T. Clarke B. A. Madson J. W. Nelson Geo. Robertson	W. H. Volck, Horticultural Commissioner
Shasta	G. H. True R. F. Miller	G. A. Lamiman, Horticultural Commissioner
Siskiyou	G. H. True R. F. Miller	W. L. Kleaver, Horticultural Commissioner
Stanislaus	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	C. M. Conner, County Farm Adviser
Solano	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	J. W. Mills, County Farm Adviser
Sonoma	T. Francis Hunt C. W. Rubel G. H. Hecke	O. E. Bremner, Horticultural Commissioner

County	Hearings conducted by	Meetings arranged by
Sutter	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	H. P. Stabler, Horticultural Commissioner
Tehama	H. E. Van Norman C. B. Lipman G. W. Hendry	C. B. Weeks, Horticultural Commissioner
Trinity	G. H. True R. F. Miller	W. C. Heustis, Forest Supervisor
Tulare	B. H. Crocheron C. F. Shaw E. C. Voorhies S. P. Frissell	C. F. Collins, Horticultural Commissioner
Tuolumne	W. L. Howard W. T. Pope L. S. Smith	R. W. Ayers, Forest Supervisor
Ventura	H. J. Webber R. S. Vaile L. D. Batchelor A. D. Shamel W. B. Rowland	A. A. Brock, Horticultural Commissioner
Yolo	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	N. P. Searls, County Farm Adviser
Yuba	H. E. Van Norman C. B. Lipman G. W. Hendry H. Weinstock	C. W. Harney, Horticultural Commissioner

OBSERVATIONS ON THE RECENT AGRICULTURAL INQUIRY IN CALIFORNIA*

MADE BY DIRECTION OF THE COMMITTEE ON RESOURCES AND FOOD SUPPLY OF THE STATE COUNCIL OF DEFENSE

By Thomas Forsyth Hunt

There are presented herewith copies of the report of each of the eight parties which conducted and completed an agricultural inquiry in California in the twelve days ending April 27, 1917. A study of the data and recommendations of these committees is essential to a complete presentation of the inquiry. It is intended with your permission to print these summaries together with other special reports and documents in the Annual Report of the College of Agriculture where due acknowledgement will be made of all the agencies and individuals who have so generously assisted in conducting this inquiry and without which its success would have been impossible. For the sake of brevity, I propose to restrict myself to the presentation of certain conclusions that have been impressed upon me not alone by the study of the large mass of data collected, but also by other facts which have come to my attention since making a previous report to this committee.

I shall not be disappointed if you do not adopt the conclusions. I am conscious of the steps through which every nation has gone which prosecutes to a final conclusion a war of the first magnitude. It first exhorts, it next admonishes, it then threatens, and finally it compels. This nation can hardly hope to escape these steps if war continues for three or more years. The best that can be hoped is that the steps may be shortened. It is, however, desirable that you who have placed upon you such grave responsibilities should be able to see to the end of the road.

Acting under your instructions an agricultural inquiry was conducted to determine as far as such an inquiry could determine, the actual condition of crops, and to point out the desirability of raising summer forage crops to the end that the output of animal products be maintained. The parties making the inquiry also gave information about the growing of certain crops with which some farmers have not yet had any considerable experience.

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* Published May, 1917.

As was to be expected, the farmers were everywhere found to be bending all their available capital and energy to the production of farm products. It is worthy of note that the men who conducted these inquiries came back inspired by the cordial support and the patriotic fervor with which the various audiences received them. Nothing in agricultural propaganda with which I have been more or less intimately connected for a third of a century has so impressed me as the enthusiasm with which these men returned from their two weeks' campaign.

It may be safely stated that never has so much capital or so much labor been expended in the production of farm crops in California as during the present season. Broadly speaking, yield of crops depends upon two factors: (1) capital, including labor, and (2) weather conditions. Unfortunately the rainfall has been deficient and temperatures have been rather uniformly below normal during several months. It is necessary to report, therefore, that notwithstanding the strenuous efforts of the farmers the total crop yields of the state will be below normal, although probably not the gross financial returns.

It is difficult to secure the actual facts through an inquiry of the kind conducted or to make a general statement that will apply to the state as a whole. The inquiry was, of course, mainly concerned in determining the yield of crops and in creating a surplus of food for our allies. The men giving testimony can hardly escape being influenced by their economic returns. A producer of prunes may anticipate only 90 per cent of a normal yield, yet if he has them contracted at 25 per cent above the usual price, he is apt to testify his crop is satisfactory, especially when with the anticipated high price for labor he reflects that it costs him less to harvest a 90 per cent crop. In the same county alfalfa under irrigation may be 20 per cent above normal, while barley hay on adjacent unirrigated land may be 50 per cent below normal. To what extent they offset each other is obviously dependent upon the relative acreage. Potatoes may be above normal in most of the counties not raising potatoes extensively but considerably below normal in regions where they are principally grown.

In general, however, field crops, that is crops other than fruits and vegetables are somewhat below normal in the Sacramento Valley, much below normal in the San Joaquin Valley and up to normal

PLANT NOW

GRAIN SORGHUMS

Sorghums will grow in hot, dry districts.
Sorghums are drought resistants.
Sorghums are an excellent substitute for corn.
Grow sorghum for grain and forage.
With irrigation, sorghums may follow grain hay.
Plant sorghums on any good, average soil.
Plant up to May 1.
On irrigated land plant up to June 25.
Prepare seed bed thoroughly with a two-inch mulch.
For grain, plant rows three and one-half feet apart; plants, four to six inches apart, in the rows; six to eight pounds per acre.
For forage, seed heavier than for grain; 30-40 lbs.
Plant seeds below mulch on moist soil.
For grain, plant dwarf milo, Egyptian corn or feterita.
For forage plant Kafirs or sweet sorghums.
Keep down weeds around young plants.
Cultivate to preserve mulch and conserve moisture.

Ask your Farm Adviser, or write the University of California,
College of Agriculture, Berkeley

chiefly in counties of relatively small acreage.* Irrigated crops are not so seriously affected in the San Joaquin Valley, but even here reports state that the cold spring has retarded the alfalfa so that one less cutting is generally anticipated. Speaking again in most general terms, the fruit situation from the standpoint of the producer and the fruit handler may aside from the question of labor be stated to be satisfactory. The indications are that fruit is not much below normal in yield, and owing to prevailing prices will bring to the state as much and perhaps more money than usual.

Some difficulty has been experienced by canners in securing tinplate and the wholesale stocks of glass jars were found to be low. A special inquiry was made by our parties which indicate that sufficient stocks of these containers are held by retailers to meet all probable demands. The College of Agriculture has recently published brief succinct instructions on the drying of suitable fruits, especially for those growers who are not accustomed to practice the well known methods of the larger operators.

The acreage of beans will probably be the largest in the history of the state. The acreage of sugar beets has also increased, although seasonal conditions causing some shortage of labor for thinning has in some instances resulted in a substitution of beans for beets. Although difficult to determine, because of properly assessing the relative influence of commercial and amateur planting, it is probable that the effective acreage of potatoes is not quite up to normal. The growing of vegetables on the farm for home consumption needs to be greatly extended in these critical times.

Owing doubtless to satisfactory prices which have prevailed for several years the ranges and native pastures are fully stocked with cattle and sheep. There is every evidence that these pastures will not be able this season to support adequately all the animals available. It is further fully established that reserves of grain, alfalfa and other forage are smaller than in any previous time in several years.

A vigorous campaign has been made to increase production of sorghums for grain and forage, and to increase silos for the preservation of forage sorghums. The proper officials of the Federal Government have been requested to make available for pasture the National parks of the state. The District Forester, Mr. Coert Du Bois, estimates that under forest service regulations approximately 30,000 head of cattle or their equivalent in sheep can thus be saved. It is estimated that there are in California 627,000 head of cattle or

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* During the two months following this inquiry, there was, owing to favorable weather, an increase in grain crops amounting to perhaps 10 or 15 per cent.

HOW TO WIN THE FIGHT FOR DEMOCRACY

1. Increase the Army and Navy
2. Build More Ships
3. Increase Food Supplies for our Allies

WHICH ARE YOU DOING

equivalent in sheep which the native pastures can not successfully carry this season. Some will go to market at relatively low prices. If the rest can be held until November, some may be transferred to the valleys to be fed on alfalfa, grain hay, and sorghums including silage, while others may at present prices be shipped to the feed lots of the central west where Indian corn will doubtless be abundant by that time. The final outcome will be somewhat influenced by the time and character of the fall rains. Whether these cattle are fed in the valleys of California or in the feed lots of the central west, without doubt higher prices must be paid for animals on the hoof next year and in the years immediately thereafter than is now being paid.

If meat production is to be materially increased in California, the valleys must take a larger part in the industry than heretofore. This will come about by bringing steers from the ranges at an earlier age to be finished in the valley while breeding cows take their places on the range.

Progress can also be made by reducing the excessive loss of lambs by the use of lambing sheds, thus reducing the number of ewes necessary to carry on the ranges to secure a given crop of lambs. A member of the staff of the Division of Animal Husbandry has been detailed to go among the sheep raisers furnishing plans of a simple lambing shed and if possible bring about better care at this critical period of the shepherd's business. This effort is too late to be beneficial during the present season.

The valleys of California can greatly increase the production of pigs and chickens, but, in order to do so, food, particularly grain sorghums, must be raised. The farmer who undertakes to increase his supply of pigs without first or concurrently growing food for them is destined to disaster.

More of the poultry of California should be raised on the farm which produces the food that they consume. California has the most numerous, large, specialized poultry plants in the United States yet keeps less poultry and produces less eggs per capita than many, perhaps most other states. The reason is that poultry are not so universally raised as a by-product of the farm as elsewhere. Today poultrymen are sacrificing their flocks on account of the high price of feed.

If a farm raises one acre of grain sorghums there can be kept with profit 50 hens which would produce 500 to 600 dozen eggs each year. The seed for this acre costs about 50 cents and even without special machinery the planting can be done in less than half a day by the wife or daughter if necessary. There is perhaps no other part of the United States better adapted to raising poultry than California.

FEED OR FIGHT

1. RAISE MORE LIVE STOCK

It is impossible to overdo this business within the next five years, war or no war.

2. WINTER FEED STEERS

Substitute cows on the ranges for steers over two years of age where-ever practicable.

3. SAVE LAMBS

Build lambing sheds to eliminate the excessive loss of new-born lambs. The U. C. College of Agriculture will furnish plans.

4. INCREASE FARM FLOCKS

Keep small flocks of sheep on farms to conserve forage not otherwise utilized.

5. DOUBLE PORK OUTPUT

Keep two brood sows instead of one wherever grain sorghums are available.

6. SAVE DAIRY CALVES

Skim milk is a food. Dairy calves should not be sacrificed prematurely.

7. GUARD AGAINST DISEASE

Report any outbreak of disease among domestic animals immediately to Dr Chas. Keane, State Veterinarian, Sacramento, Cal.

8. SILOS CONSERVE FEED

Build silos for the storage of non-saccharine sorghums, sweet sorghums or Indian corn. The U. C. College of Agriculture will furnish plans and supervise without expense, the building of silos by community effort. The materials cost about $1.50 per ton capacity.

Ask your Farm Adviser, Forest Ranger, Horticultural Commissioner, or write to the **University of California, College of Agriculture, Berkeley, Cal.**

The lack of poultry production except as a specialized and commercialized industry is due, doubtless, to the Californians' traditional dislike for small things.

Upon the important subject of fish, which your committee directed a report to be made, the investigations indicate that the supply can readily be increased to meet any reasonable demands. Doubling the supply of fresh fish is merely a matter of increasing the nets. I hesitate with my rather limited knowledge of the situation to offer concrete suggestions, but I am convinced that with further study it would be possible to increase consumption of fish without increasing the price to the consumer. By proper co-operation the consumers' prices may even be lowered. Here, as in many other cases, high prices paid are the fault of the habits and exactions of the consumer and can be remedied only by his assistance. At any time and particularly at this time, an abundant and wholesome supply of fish is an important asset to any community.

The most frequent statement found by examining the detailed reports on horses and mules is "supply about equal to present needs." Several counties report horses for sale, one county reporting some horses for sale because of the high price of feed. Independent investigations of horses available for the army are less optimistic. It is generally conceded that relatively few horses meet the cavalry requirements. It is also certain that there can be no considerable extension of the present cultivated area, nor more intensive cultivation of areas at present under cultivation without more power.

While in a military sense this country has been engaged in war but a brief period, if at all, yet from the standpoint of the labor and food supply the United States has been in this war since August, 1914. It is not strange, therefore, that the agricultural inquiry should develop the farm labor situation to be one of the high lights. Our entrance into the war as a military aid to the Allies will serve to intensify the situation somewhat, the extent to which this will occur being dependent upon the methods of taxation adopted to meet the war loans. It was reported to our inquirers that in one-half of the counties the labor supply was sufficient to meet present needs, while three-fourths of the counties reported they did not expect to be able to secure sufficient labor within the country to meet the peak load.

In considering the labor situation it is necessary to recognize that a belief in a shortage of labor is a chronic state of mind on the part of many producers. I began employing and superintending farm labor thirty-six years ago and I have been at it almost constantly ever since. During that time there has never been a year that farmers of a certain type have not complained about the shortage, or the high price of labor. All this has occurred in the face of the fact that most farmers are benefitted by the high price of labor, for most farmers labor with their own hands. In some cases most sensational statements have been made to our parties apparently with ulterior motives. These statements when investigated by men especially detailed for the purpose have been shown to be either grossly exaggerated or without any foundation in fact. However, after discounting this hereditary state of mind and the sensationalist who wishes to take advantage of his country's condition in the interest of his personal ends, there still remains an acute farm labor situation.

A member of one of our survey parties returned with this concise statement:

"The big fellow wants labor, the little fellow wants capital." This statement was based upon observation and not on any theoretical consideration whatsoever. Nevertheless, the fact is based upon the soundest economic laws and represents an age-long controversy. It is to the economic interest of the large property holder, who employs labor to do his work to have the rate of interest high and labor cheap. His economic interest is not served by rural credits. On the other hand, the renter, or the man with a small equity in his land who daily toils with his own hands has his economic status promoted by cheap money and dear labor.

Finding the situation as it is, the problem was attacked in three directions.

1. A farm to farm post-card canvass of the actual labor needs was begun, every farmer being asked to give the essential data concerning his individual needs. The following is a sample inquiry:

The ——— County Farm Bureau is compiling a labor directory. We would therefore like to know whether you will need help on your ranch this year—more than you can supply yourself. If so, please fill in the attached postal and mail. We will make a summary of the returns and assist you to secure help when you need it. Don't delay, but mail the postal at your earliest convenience.

(Return Card) ....Cal.,
..............................1917.

I will need..........men and..........women and..........children during the period of..........days in the months of..........to help in.............................. (picking prunes, etc.)

I will provide:
Board and room..........
Camping grounds..........
House..........
Water..........
Sanitary conveniences..........

I will pay:
Per box..........
Per ton..........
Per day..........
Per month..........

(Name)..............................

Such a canvass is now being conducted in seventeen counties and will be rapidly extended throughout the state provided the results obtained in the seventeen counties justify such action.

2. Consideration has been given to the best methods of making a house to house canvass in all the large cities in order to develop the supply of labor which can actually be made available for farmers. Consultation with men of experience in handling the labor problem in the cities seems to indicate that this can be done more readily than was at first supposed possible. Your committee already has such voluntary offers as make it seem probable that this task, stupendous as it may at first seem to be, can be accomplished within two weeks whenever it is desirable to do it. Of course it could not be done except under the stress of the patriotic motive. It has not been deemed expedient to have this canvass made until more definite information concerning the character and extent of the farm labor and the time when needed have been obtained. Further, the work can be more effectively accomplished after the registration for enlistment has been completed.

3. A plan is being developed to make the largest possible use of the 47,000 high school boys of California. Before a state of war was declared, the College of Agriculture in co-operation with the U. S. Department of Agriculture and fifteen high school teachers had approximately 2000 high school and elementary boys growing crops in club contests.

The second week in April the college called upon these boys to grow additional crops and to volunteer their services in spreading agricultural propaganda and in otherwise assisting local agricultural officials. The response was so marked that on April 30 eight members of the staff of the College of Agriculture began a canvass in the high schools outside the large cities in an attempt to induce the 20,000 boys so situated to grow crops. The next step was to outline a plan by which the remaining available boys might be mobilized to help in the coming harvest. The plan was first informally outlined at a meeting of the members of the State and County Councils of Defense in San Francisco, Thursday, May 3, and unanimously endorsed.

It is not to be understood as a method of solving the whole farm labor problem, but only a certain important phase of it. It may also be pointed out that this is the only large question connected with increasing the food supply, and hence, with the prosecution of the war, that is not primarily a federal matter. The Federal Government has no jurisdiction over the state school system at present, and will have only an indirect one after July 1. In all other matters

PROFIT OR LOSS

The University of California Department of Economics says: "There are two reasons for the vast increase in prices.

1st. The increase in money in circulation, including credit instruments.

2nd. Actual scarcity of food and an abnormal demand. War or no war, food prices generally will not fall in the next two years because:

1st. The money in circulation cannot be called in.

2nd. The abnormal war demand will absorb all possible increase in supply.

3rd. Hold-over stocks of primary foods have been consumed. This increases all other food prices.

The crops of wheat, barley and oats in the United States in 1915 were the largest in our history, yet prices were the highest since the Civil War."

DO NOT BE AFRAID OF OVER-PRODUCTION

the state at best can act only in an advisory capacity. In the very nature of the case, as the war progresses, these state activities will become more and more inconsequential.

The important question is to secure appropriate action providing for the employment by the several boards of education of such teachers as may be needed. The State Board of Education may possibly be able to supplement this action by the use of Smith-Hughes funds amounting to about $20,000. If it has any question about the legal use of the funds it can easily have the national and state officers pass upon the question, i.e., P. H. Claxton, Commissioner of Education, Washington, D. C., and Wm. D. Stephens, Governor of California.

According to the Superintendent of Public Instruction there are 47,000 young men in the high schools of California. Not all of these will be available for employment on farms, because—(1) some will work at home; (2) others will work at other occupations; (3) some may not work at all. However desirable it may be to have these young men also supervised, it can hardly be said to be necessary for the purpose of meeting the present emergency.

When the employment of teachers is settled, then the method of placing and supervising the young men will need to be worked out by the State Council of Defense through its Committee on Resources and Food Supply. In some cases, particularly in the larger cities, the high school students will be taken to distant places to work in groups of ten or more. They will generally live in camps and have a common mess. When necessary, it will be the duty of the teacher to mobilize the required materials, to organize the camp, to make contracts with employers concerning pay, to determine that the boys are given only reasonable tasks to do, and to look after the welfare of the young men, especially during the unemployed hours. It is not to be the duty of the teacher to take the place of the employer in seeing that the work is properly done.

In other cases, particularly in the smaller towns, it will be necessary to scatter the students about one, two, or three in a place. In these cases it will be the duty of the teacher to make the arrangements concerning pay, to determine that the rooming and boarding accommodations are adequate, and to visit the farm periodically to determine whether the arrangement is satisfactory to both parties.

It is to be kept in mind that if the war continues for three years or more, many of these young men will become liable for draft. The important question, therefore, is not the amount of money earned or saved, but it is the physical condition in which these young men return to their homes and their school duties. Hence it is proposed that plans shall be developed to prevent overwork. For illustration, if a rancher needs eight men working ten hours a day, he would be furnished with ten men who would work only eight hours a day. If he paid $2.00 a day for ten hours work, each young man working eight hours a day would receive $1.60 per day. If $2.50 was the ten hour rate, then the eight hour rate would be $2.00. It is believed that these young men working eight hours a day would soon be able to render as effective service per hour as the usual farm laborer who works ten or eleven hours.

It is not the purpose of this plan to lower the price of farm labor, but rather to furnish additional labor at the time most needed, at reasonable prices and under proper living conditions, in order that the state may have a body of virile, well-trained young men. It is believed, therefore, that these young men should not be made available below a certain minimum wage, whether the pay is to

be by the hour or by the piece. These young men should not be placed, either in groups or singly on farms, until the supervising teacher has determined that a reasonable wage can be earned by working eight hours, and this wage should not be less than four-fifths of the amount earned by farm labor working ten to eleven hours per day.

Everyone knows where the high schools of his community are, so that in so far as any county is concerned, the ability to supply the labor which high school men are able to perform, should not be difficult. There should be no difficulty in employers making their wants known. However, when it becomes necessary to move men from the large cities to adjacent or distant counties, a clearing house will be necessary. This task the State Council of Defense will undertake, through its Committee on Resources and Food Supply.

This plan was fully discussed at a conference between this committee and members and representatives of the State Board of Education on Monday, May 7, and was formally presented for action at the meeting of the Board of Education on Monday, May 14. On Wednesday, May 9, a group of twenty-four Berkeley High School boys went to one of the islands of the Delta to cut asparagus, in charge of a teacher of the Berkeley schools, who is paid his salary and expenses by the Board of Education. To make this initial experiment, Mr. W. B. Meek not only agreed to raise the price paid for cutting asparagus, but voluntarily organized suitable living conditions under the direction of the State Immigration and Housing Commission, which has been co-operating with your committee in the most vigorous fashion. It is reported that large numbers of boys have gone out from the high schools of the state, notably in southern California, to help cultivate or harvest crops.

Every man, woman and child on whatever pretext, who goes into the open country this summer, will help to relieve the food situation (1) by reducing the cost of transferring food from the country to the city; (2) by living on simpler fare, and (3) by consuming supplies which while perfectly wholesome and palatable, never find their way to the cities for purely economic reasons. If foreign labor is brought to this country, the mouths to be fed will be increased, but if the city population is transferred to the country a saving of food will result.

Although your committee has hardly touched the edge of this problem, it is evident it is going to be one that will require much patience and many readjustments. Even before war was declared $2.50 for an eight-hour day without board had become the customary wage for ordinary manual labor in all the larger cities of California. Farmers who employ considerable groups of laborers complain not without reason that their industry has not been organized on that basis, since they have had access to labor which did not find steady employment in the cities at that wage. Whether unfortunately or fortunately this class of laborers has since August, 1914, been gradually absorbed into the industrial activities of the nation and is no longer available for farm work at the old rate of wages.

The extra labor which the farmer will employ this summer and probably for several summers hereafter must be largely from those who have come to look upon $2.50 for an eight-hour day without board as a minimum wage. Just what is the equivalent of this wage in the open country it is difficult to state dogmatically, but it is safe to assert that the farmer will find it necessary to organize his business on a higher wage basis than at any time within the memory of most men now living. In trying to organize farm labor primarily to aid in winning this war, the writer has not been unmindful of the interests of the farmers themselves. He, however, finds the solution hopeless unless they will meet the situation at least half way both by offering increased wages, and what is equally important, better living conditions than have obtained in the past in some instances. This means without doubt that the farmer must get more for his crops than ever before. He will not continue and he cannot continue to employ labor at greatly increased prices without a somewhat corresponding increase in his products. The man who is raising crops with his own hands and the help of his family is in quite another category.

The plans just outlined are being carried out with every possible dispatch not because it is believed they will be sufficient to meet permanently the farm labor situation, but because they are the methods which it seems possible to put into practice at the moment. The farm labor problem can not be considered apart from the rest of the activities of the nation. Without doubt, if the war continues for three or more years, radical measures will be necessary. Many of the activities now conducted by able bodied men between the ages of eighteen and forty-five will either have to be eliminated or be conducted by boys under eighteen, or men over forty-five, or by women.

While certain indulgences necessarily must be curtailed, the experiences of the present war teach that it is not safe to limit unduly the opportunities for recreation nor to fail to recognize the value of modern labor conditions. Our allies have found that music and art have human values that may not be omitted in war times. Nevertheless there are some things that can be done with perfect safety. Men can run their own automobiles and women can for the most part do their own shopping. Both men and women can economize on dress.

It is not necessary for any man between the ages of eighteen and forty-five to clerk in a retail store or wait on the table in any club, hotel, or restaurant. Furthermore, in any real war it is not done, as the English would say.

Every effort should be made to reduce the cost of retail delivery. Hence buying in large quantities, popularly referred to as hoarding food supplies, is to be commended. While the transition is taking place between the old process of microscopic telephone purchases and that of the personally selected wholesale purchases there will be, as in all other trade changes, certain derangements and hardships and if after the first spasm of fear or of righteousness as the case may be, is passed, the purchaser falls back into the old method then nothing but harm can come from it, but as a permanent system the so-called hoarding of food supplies which is nothing more than wholesale or original package purchases is to be fostered by every possible means, because it reduces the cost of retailing, which is approximately one-third of the consumer's dollar.

Everywhere our parties have gone the farmers have shown an undoubted patriotism. The following extract is submitted from a letter which was received from a farmer who attended one of our hearings.

> ''Speaking on the subject of patriotism, the present price of wheat is $3.85 per hundred, which is *too much*. I am willing to sell my crop for $2.50 per hundred, provided a large number of farmers will do the same. My crop will aggregate 4000 sacks, I believe, and I will give 10 per cent of it and roll it to market at my own expense and send it to the cities of the state to be given to the families who are or will be without food.
>
> I will further state that if there is no patriotic movement of this sort I will sell my crop on the market and whatever it brings over $2.00 I will put it in a fund to buy other food products for the families who have no food.''

Nevertheless, our parties could not help sense the undercurrent of fear concerning overproduction and the feeling in the minds of the listeners that our advocacy of a given crop or crops made overproduction just that much more certain. To offset this attitude a placard has been widely distributed entitled ''How to win the fight for democracy,'' which aimed perhaps unnecessarily to indicate what alternatives were before the citizen who wished to do his ''bit.'' A placard prepared by the University of California Department of Economics entitled ''Profit or Loss'' is being distributed in which it is asserted that ''War or no war, prices will not generally fall within two years.'' This was done in an attempt to increase production in order that there may be a surplus of food for our allies. Along comes this unfortunate agitation for the control of food prices. It is barely conceivable that some person may work out a satisfactory plan, but the present discussion which means a thousand different things to seven million different farmers only causes the farmer to hesitate to extend his operations.

It is not true that the primary necessity is control of food prices. The primary necessity is a surplus of food for our allies. Such methods must be evolved and such sacrifices must be invoked as will produce this surplus. What shall it profit the United States if it reduces the price of wheat and thereby loses this war?

In order to make this situation clear I permit myself the following primer-like cross-examination:

The average farm-owning farmer is perhaps not going to be much affected by this discussion. He has his capital, his machinery, his animals, and the labor of his own hands. He is going to follow his usual course of doing the best he can with these agencies. If prices are not too low and labor not too high, he may perhaps extend his operations somewhat, but for the most part he is going his way through wind and weather feeding the nation in about the usual manner. He cannot be expected to do much more than he always does, because he generally does all he can, the assertion of unthinking people to the contrary notwithstanding. How then is increased production to be obtained in California? I presented at our hearing in San Francisco the situation as it appeared at that time, from which I quote in part as follows:

> What has a great city to do with the production of foodstuffs for our allies? The answer is that if anything more is done than is already being done, it must be by the people of the cities, primarily by those of the large cities. Most people think that the raising of a surplus of food products is a rural problem. It is not. It is an urban problem.
>
> Every farmer is now working at top speed. He is using every dollar of capital and every ounce of muscle he possesses. The farmers are anxious and willing to help, but without the aid of the cities they are powerless to do more.
>
> There are about one-quarter of a million persons in California engaged in agriculture and allied industries. There are approximately one million in other gainful occupations. In the United States as a whole of every three persons in gainful occupations one is engaged in agriculture; in California the ratio is one to five. This is no time to discuss reasons. Suffice it to say that assuming a three years' war, one-quarter of a million people now in the cities of California will be needed to win this war. Fifty thousand will be required for the army and navy and for ship building, and 200,000 will be required on the farms. Twenty thousand are needed at this moment in the open country.

Our inquiry shows that there are considerable areas of land now available for irrigation and water ready to be applied which is awaiting new capital and additional men to make them productive. In

Why all the agitation concerning food?

IN ORDER TO FURNISH A SURPLUS FOR OUR ALLIES.

How can a surplus be obtained?

BY INCREASING THE PRODUCTION OF FARM PRODUCTS.

BY DECREASING CONSUMPTION AND ELIMINATING WASTE.

What is the most effective means of increasing production?

INCREASE IN THE PRICE OF FARM PRODUCTS.

What is the most effective means of decreasing consumption and eliminating waste?

INCREASE IN THE PRICE OF FOOD STUFFS.

What is the objection to agitation for the control of food prices?

IT CAUSES THE PRODUCER TO HESITATE.

IT MAKES THE CONSUMER INDIFFERENT.

When will the price of food stuffs ease off?

WHEN OUR ALLIES HAVE AN ABUNDANCE OF FOOD.

Is the sacrifice too great?

IT IS SMALL COMPARED WITH THE SACRIFICE THAT IS MADE BY THE SOLDIERS WHO HOLD THE FIRST LINE OF TRENCHES.

co-operation with the State Engineer a conference was held on Tuesday, April 17, with a considerable number of water companies and later correspondence was conducted with others. On Friday, April 20, a conference was had with the State Railroad Commission and the State Water Commission with the result that the State Railroad Commission issued an order that during the period of the war water could be furnished at less than usual rates or free of charge without permanently dedicating the use of the water to the land. Through the efforts of the State Water Commission suitable legislation was enacted giving mutual water companies similar powers. It is estimated that approximately 200,000 acres of land will be brought under irrigation for the first time in 1917 which is above the normal increase and water for 500,000 additional acres will be available next year. In California it requires, normally, 25,000 men to cultivate half a million acres of land. For each person engaged in agriculture in the state in 1910 there were invested in land, tools and animals $7000. How can men in the cities be found who will use their capital or their labor as long as a threatened food control whose significance is unknown hangs over them? If this were the proper time to experiment with untried economic theories, however good they may be in themselves, it would not matter, but the necessity of the hour is a surplus of food for the allies. If the State Council of Defense can do anything to clear up this situation immediately it is not too strong to say that it will be doing a lasting service to mankind.

In response to the appeal for more power on farms made at the San Francisco hearing a Committee on Tractors was appointed by Mr. C. H. Bentley of your committee, with Mr. Adolf Mack of San Francisco as chairman. This committee has been actively engaged in considering the feasibility of mobilizing existing tractors and in discussing methods for increasing the manufacture of new ones. There is especial need of a plan to increase the number of effective hours per year per tractor. A system of tractor garages, where a number of machines would be kept, might be developed so that a farmer who may need a tractor not more than one, two or three days in a year may order his work done either by the day or acre. This would result not only in more land being plowed, but also in that the plowing would be more efficiently done. There are in California 100,000,000 acres of land of which approximately 5 per cent was under the plow in 1910.

If I do not misjudge the temper of the people they are ready to contribute rather freely to any humane or charitable enterprise which is the outgrowth of the present conflict. The response is particularly hearty when the aim is to relieve suffering. "Save your money for the Red Cross'' is the common and often jocular expression which represents this wholly commendable attitude. On the other hand, there seems to be a settled conviction that anything that has to do with the prosecution of this war is a governmental enterprise and should be a direct tax on the people at large. I am not commenting upon the propriety of this point of view, but I call the attention of the committee to the reality with which it must deal if its efforts are to become effective.

One of the chief items which on April 10 your committee asked that consideration be given was the conservation of food and the elimination of waste. The machinery for this task was created by the appointment of a committee of dietitians and others with a member of your committee, Miss Ethel Moore, as chairman. A memorandum entitled ''Seven ways in which money is wasted and how to save this waste'' was immediately prepared and sent to 225 teachers of home economics in the state and widely circulated in the press. It was also placed in the hands of the president of the State Federation of Women's Clubs. A strenuous effort is being made to enlist this organization, with a membership of 40,000, as well as other women's organizations, in promoting the practice of economies. The subcommittee is preparing and distributing a list of menus, tracts on drying and otherwise preserving fruits and vegetables, and on the rearing of poultry. It is now fully established that the winter wheat crop of the United States will be below normal, probably so much below normal as to make it impossible for a bumper spring wheat crop to offset the winter wheat shortage. When the demands of our allies are taken into consideration there is every reason to believe that high prices for wheat must continue to prevail. The public should not be lulled into feeling that by some legerdemain they are going to secure cheap food in the near future.

There is every reason to believe that this country will have an abundant corn and oat crop. Fortunately, they are both admirably adapted to human consumption. Without doubt the supply of corn will be four times as great, and that of oats as great as the wheat required for home consumption. Notwithstanding the fact that the Indian corn crop of last year was the smallest in several years, there is in sight at this moment corn enough to furnish food for our population for a whole year if there were not a pound of wheat in existence. It is, of course, not desirable that wholesale substitution of corn and oats for wheat should be made, because the meat supply would thereby be curtailed. Nevertheless the consumer should be taught that the proper course is to cut down meat bills and to substitute for wheat, so far as practicable, corn, oats, rice, and barley. So far as the adult population is concerned this would probably result in a general increase in health. There is need of care, however, in making radical changes in the dietary of growing children, who are in special need of the kind of protein furnished by meat, milk, and eggs.

An investigation of the garbage of one city in California made by Dr. C. M. Haring of the College of Agriculture shows that if this garbage were fed to pigs, the pork produced would be equivalent to 1 per cent of the total food consumption of that city. Probably the most practical method for the householder to deal with this waste is to keep from three to six hens. Care should be taken not to keep too many fowls, because if the waste product becomes too small a proportion of the food consumed by them, they may no longer be economical. The College of Agriculture is publishing a circular on city poultry-raising, with plans for suitable quarters for a small number of fowls.

Belgian hare furnish a wholly nutritious and healthful source of meat. They, however, do not consume waste products, being best grown on a diet of dry alfalfa and barley meal.

It gives me pleasure to report that the probable allotment of funds from the Secretary of Agriculture for the further extension of the County Farm Bureau system will make it possible to serve you more efficiently in the future. Both the present facilities and these added ones are at your disposal subject to the approval of the President and the Regents of the University, which I am sure may be assumed.

CONCLUSIONS

I have therefore in conclusion to report to your committee that the tasks that lie immediately before it seem to be as follows:

To bring the labor resources of the cities in touch with the labor needs of the country by a family to family convass of both city and country and to act as a clearing house for this information.

To organize tractor garages or similar methods of giving the farmers more power.

To urge city capital and city people to engage in the production of food in the open country, particularly on those lands on which water has recently been made available.

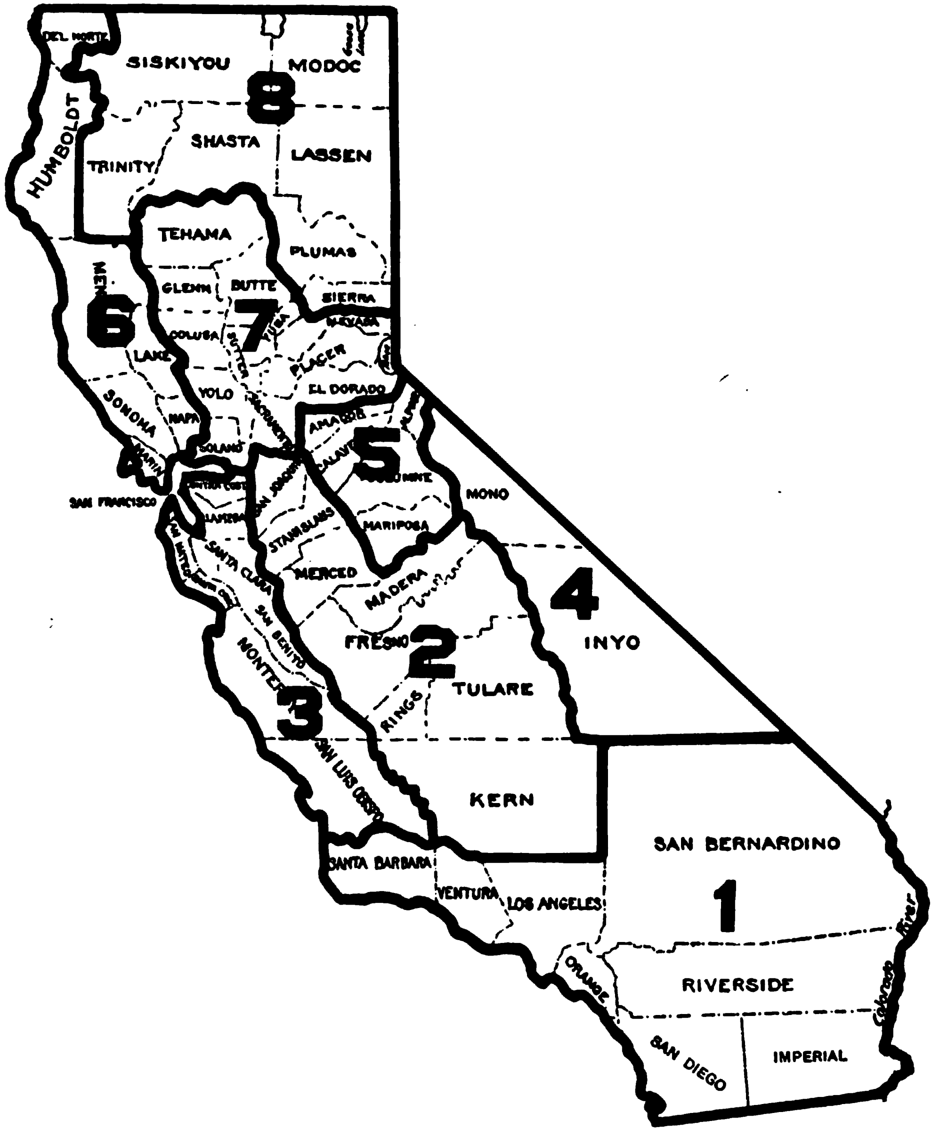
To further promote plans of meeting the livestock situation and to promote a larger use of the abundant supply of fish which can readily be increased.

To furnish organizations of women with information concerning the conservation of food and the elimination of waste and to impress upon them the great possibility of state and local associations in promoting economy in food and clothing and in eliminating such indulgences as are not strictly necessary to the best welfare.

To assure the producer that whatever food control may mean that prices of food products can not appreciably decrease in the next two years, and to warn the consumer that the sooner he adjusts himself to the present or higher scale of prices, the better it will be for him and for the cause for which this country is fighting.

And now finally, the pity of it all is that very little attention will be paid to most of these recommendations. There will be in the hands of the American public during the next two or three years more money and instruments of credit per capita than there ever were in any nation of the world, and there is every reason to believe that this country is to witness the most prosperous times and the most riotous living that it has ever known. In the meantime it is our allies who will suffer.

> For what shall it profit a man if he shall gain the whole world and lose his own soul?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SUMMARY OF THE REPORTS OF FIELD PARTIES CONDUCTING AGRICULTURAL INQUIRY, APRIL 16–27, 1917

1. SOUTHERN CALIFORNIA

By L. D. Batchelor

Crop Conditions.—Citrus crops are normal or above in practically all counties. A total tonnage of 110 per cent of normal seems likely. Deciduous fruits are normal or above in all counties except Riverside and Orange, where the late frosts did some damage to the stone fruits. A walnut crop of 115 per cent of normal is anticipated. There has been an increased planting to beans in all counties except Santa Barbara, where this crop is already very important. A total tonnage of from 125 to 150 per cent of normal is indicated. A normal crop of beets is expected. Threshed grain is below normal on the dry-land areas, but equal to normal on the vast irrigated areas of Imperial County. The milo planting is above normal, mainly in Imperial County, where 100 per cent above the usual crop is expected. The potato area has been increased to a considerable extent in Santa Barbara, Riverside, and San Diego Counties. The total crop of the entire area will apparently approach 150 per cent of normal. Fresh vegetables for commercial purposes are apparently normal, but there is a marked increase in the number of home vegetable gardens. There has been considerable increase in the cotton acreage in both the Palo Verde and the Imperial Valleys; 150 per cent of the normal crop is anticipated.

Grain-hay will apparently fall from 30 to 40 per cent below the normal production. The carrying capacity of pastures is below normal in most instances, approaching 75 to 80 per cent of the usual amount. The alfalfa crop will apparently be below normal, as the acreage in Imperial County has been reduced to plant cotton and the cold, backward spring has reduced the tonnage throughout the entire area.

Intercropping.—This practice is normally well established in the coastal sections, where the bean crop has proved to be a reliable and profitable crop to grow between trees. The interior regions do not normally intercrop the orchard, due to lack of initiative, water shortage, or lack of adaptation of soil and climatic conditions to profitable crops. It will be possible to increase the intercropped areas of orchard land in Southern California by from 40,000 to 50,000 acres. This land naturally is already well cultivated and irrigated, and often includes the best agricultural property of the various sections. Much of the inland section will be planted to beans during the current year, as all indications point to a profitable disposal of that crop. Beans are by all means the most popular and apparently the most profitable intercrop for an orchard, winter cabbages or early potatoes coming second. There is a feeling that corn or grain sorghum may be harmful to the young trees as well as being less profitable than beans.

There will be need of competent advice on bean culture in those sections where this crop is being grown for the first time this year.

Double Cropping.—This system can be profitably practiced in the warmer inland sections, where such a crop as milo may follow cantaloupes, barley, or any of the early vegetable crops. The coastal areas are less promising for a practical form of double cropping. Here the opinions are very strong that double cropping means two poor crops rather than one good one. The cool weather shortens the growing season in that area, while an abundant amount of irrigation water after a certain seasonable period serves only to cool the soil and retard growth rather than hasten it. The greatest area which will be double-cropped during this season and the one which gives greatest promise for this practice, is Imperial County, where there will apparently be a 100 per cent increase in acreage of milo planted, estimated at 100,000 acres, largely on land which has already produced one crop. Tepary beans might follow as a second crop after cantaloupes.

It has been suggested that early fall barley might well be planted in September and October between the rows of short-staple cotton and provide 50,000 acres of pasture for a short period. There is an anticipated shortage of forage for feeders in Imperial Valley next fall, due to much land being given over to cotton and milo.

Extension of Irrigated Areas.—The irrigated land could be greatly increased by the enlargement of irrigation systems already established; these areas, amounting to a total of 100,000 acres, more or less, which might be irrigated in 1918. Probably the most notable areas are: first, the San Joaquin ranch, at Tustin, Orange County, where there are 25,000 acres of land now being dry-farmed, which could be watered from wells already in existence, by merely extending distributing pipes; second, from 10,000 to 40,000 acres in Imperial County, water for which could be obtained in 1917 by a temporary weir in the Colorado River (after the current season the extra water will be obtained by a new and permanent "in-take" now under construction; however, if the farmers were assured of this late water which the weir would furnish, they could greatly increase their milo acreage this season); third, 15,000 acres in the San Fernando Valley, which could be brought under irrigation by the extension of distributing service. The practicability of developing these several projects may vary widely.

Surplus Water.—This will bring about an increased production during the current year by making use of extra water now held by private water companies and individuals. The recent action of the state legislature in passing an emergency water bill will make this greater production possible.

Labor.—There is a general shortage of labor throughout most of the district covered. At present this shortage is more acute in Imperial, Los Angeles, Riverside, and Ventura Counties, and unless some unusual steps are taken, will probably be more acute at harvest time. A general shortage in the back country of all counties seems more acute than in the country surrounding the larger towns and cities. The greatest shortage during the spring and early summer months will be felt in connection with the beet thinning in Ventura and Los Angeles Counties; the apricot harvest in Ventura County; cotton chopping, cantaloupe, grain, and alfalfa harvest, and milo planting in Imperial County. The shortage of labor for beet thinning is not due to a smaller number of laborers than usual, but rather to the fact that the growth of early beets has been retarded by cool weather, and therefore both early and late beets will need thinning at the same time. More men are in the beet fields than normally.

The most acute shortage will apparently come from September 15th to November 15th, and especially during October, when practically all the counties of southern California, excepting Imperial, will be harvesting one or more of the following crops: beets, beans, walnuts, apples, and grapes. There is an estimated shortage of from 7000 to 8000 laborers during the period of September 1st to November 15th for the crops mentioned. Furthermore, the cotton and milo harvest will begin in Imperial Valley and Palo Verde Valley before the above crops are fully harvested in the more northern sections. The Imperial Valley shortage is estimated at the present time as approximately 4500 men to work on the cotton and milo harvest from October 15th to January 30th. If it were possible to take care of the shortage on the coastal areas so as to hasten the harvesting of beets, beans, and walnuts as early as under normal conditions, or possibly even earlier, it might be practicable to move the necessary 4500 laborers to Imperial Valley for the cotton and milo. The large percentage of this labor must be done by men, especially on the beets and beans. However, women and children can be used very efficiently in harvesting walnuts, apples, and cotton. The suggestion was frequently made that the total county or local labor requirements could be reduced if the various agriculture interests would establish a clearing-house for labor. A plan might be thus arranged whereby each interest could handle a considerable number of men during their peak load, and an attempt be made to house properly and to employ such labor throughout the entire year. The evils of depending periodically upon migratory labor are especially emphasized in Imperial County.

The abnormal migration of Mexican laborers from one section to another during the current season has been due apparently to a high and fluctuating labor wage. The probable return of any amount of this labor to Mexico seems unlikely. Steps should be taken to gain the confidence of the Mexican laborer.

Recommendations have been made that industries which are employing men and energy in a manner not constructive to the welfare of the nation should be temporarily eliminated. Large amounts of labor and produce could be appropriated from the liquor business, thus raising the efficiency of thousands of men.

City improvement might well be delayed until after the war crisis.

The shortage of labor in Imperial County might be materially reduced if more favorable railroad rates were established to transport migratory labor in and out of the valley.

Machinery, Tools, and Work Stock.—There is apparently no abnormal condition in farm machinery and work stock in this region as a whole. No shortage is anticipated, with the possible exception of a lack of sufficient bean-harvesting machinery in San Bernardino County, where the acreage of beans has been increased about 700 per cent.

The point is further brought out, however, that the use of tractors in leveling and preparing land in some of the newer sections, as in the Palo Verde Valley, is a much more economical procedure than by the use of horses or mules. The tractors conserve both man power and capital, as well as time. None of the sections visited felt that there was any appreciable surplus of farm work stock.

Capital.—There seems to be a wide variety of conditions existing surrounding the availability of capital for farming operations. In Santa Barbara, Ventura, Orange, and Los Angeles Counties there is little or no complaint on the part of the farmer. On the other hand, the so-called back country, as Antelope Valley, Los Angeles County, and parts of San Diego County, as well as Imperial Valley in general, feel that money is not always available to finance farm operations; that is, on such terms as it is practicable for the farmer to meet. Crop mortgages are not sought after by the bankers of Imperial Valley this year, and in fact such mortgages will seldom be made until a crop is well started; in case of the cotton, for example, not until after it is chopped and there is indication of a normal harvest. Apparently the farm tenants and newcomers in most of the sections have difficulty in obtaining sufficient capital under the present banking conditions.

Seed.—There is no general shortage of the common farm and garden seeds for the current season. However, the supply of beans, onion sets, and sweet potatoes are short in certain sections. There will likely be an abnormally small carry-over for 1918. This especially is true of the crops which have been planted in unusual amounts this year.

The selection of high-grade seed may be the most economic means of increasing the production of our various annual crops. It seems important that steps be taken to provide the best possible grade of seed for the 1918 planting. The location of blocks of especially pure and desirable strains of the several crops might well be undertaken by the government agencies. If a pure strain of milo were planted, it would be possible to harvest it by machinery; whereas the present uneven growth due to mixed seed makes hand-picking necessary.

The proper storage of such seed and its sale to the farmers in 1918 at only a reasonable profit might well be assured.

Land for Summer Fallow.—Dry-farm land which might be summer-fallowed amounts to 11,000 acres, more or less; some of this land has not proved profitable during normal years of the past. The whole question of the increase in acreage of improved farm land during the period of the war may be debatable, as it is increased production rather than increased acreage that is being sought. With the shortage of farm labor and the time which is involved in bringing these areas under cultivation, the question might well be asked, cannot a greater tonnage be produced by a more intensive agriculture on land already cultivated?

Live Stock.—The condition of all cattle is apparently normal, with the exception of Los Angeles County, where their condition is considered to be slightly below average.

Dairy cattle are apparently normal (as to condition and number) throughout southern California, except in San Diego County, where the milch cows are increasing in number.

The number of beef cattle in the entire district is apparently normal with the exception of Imperial Valley, where the number of feeders is estimated to be only 75 per cent of normal.

Milch goats are becoming more prevalent in this area; animals are in good demand and the supply seems to be short.

A general decrease in the poultry population of the area seems very probable, due to the high cost of feed. In only two sections was there any apparent anticipation of increasing the poultry, namely, in Imperial Valley and Orange County. In the Imperial region, where there is a marked increase in milo planting, there is thought to be a 50 per cent increase of poultry. In Orange County it was felt that a possible increase of 10 per cent would be realized, notwithstanding the high price of feed. The small poultry raiser in some cases might profitably grow milo in the home garden following early vegetables, and thus make it more practicable to retain his flock.

Rabbits.—In general the increase in rabbit production was looked upon as a home enterprise. Only isolated cases considered this a commercial industry.

The hog population is believed to be below normal (Imperial Valley especially). No accurate counting is possible at present to verify this opinion. With the increase in milo planting, especially in this valley, it seems safe to encourage the production of swine even above the normal number. The marketing of hogs is not on a satisfactory basis in Imperial County; there is an apparent discrimination against even the corn-fed hog of this section. Alfalfa-fed and poorly fitted stock of the past may be responsible in part for this unfavorable differential. Steps should be taken to assist the hog raiser in the proper marketing of his product.

The probability of increasing the livestock in general seems doubtful. There is an apparent shortage of all kinds of grain hays and in general the production of alfalfa is below normal. This is due in part to the breaking up of large areas of forage land in Imperial County for the production of cotton, and a similar reduction of hay land in the coastal counties due to the increased bean acreage.

Vegetable Supply.—Local supplies of vegetables in southern California come to a considerable extent from without the counties. In Los Angeles and Orange Counties the local demands are largely met and quantities are exported. This condition is explained in part by the fact that soil and climatic conditions, and the proximity to the large quantities of stable manure to be had at a reasonable price, makes the section around Los Angeles especially well adapted to the production of vegetables. The opinion prevails in many of the outlying sections that the general vegetable markets of the community can be supplied more economically from without the county than from within.

Home vegetable gardens, however are much more common this year than usual, with possibilities of increasing the total production of vegetables. In San Bernardino County it is estimated that the production from home gardens will exceed the normal about 150 per cent. There is a need in many localities of public instruction in garden making, to be followed up throughout the summer months. The high-school instructors in agriculture might well be enlisted for this work.

The farming of vacant city lots is looked upon from many different angles. It depends in part on the adaptation of the soil for vegetable gardening. In such sections as parts of Los Angeles, Ventura, and Orange Counties, where natural conditions favor vegetable production, the farming of city lots may be followed with success, if the people are already equipped with the necessary tools and the water rates are low. However, the production of vegetables on city lots which are not adapted to agriculture and by people who are not farmers may be a questionable procedure.

Crop Pests prevailing in the sections visited include the various insects and diseases on fruit trees, which as a whole are well controlled. The grain and hay pests come in for only normal consideration, except in Imperial Valley, where the grasshoppers periodically do an excessive amount of damage. The bean aphis is prevalent in the coastal areas, but there is a great diversity of opinion as regards the damage done by this pest. Some farmers even maintain that the plant infested with aphis is as productive as a normal one.

There is a persistent demand for better squirrel and rabbit control in the back country of San Bernardino County, and in the Goleta section of Santa Barbara County. Apparently there will be an unusual number of aphids on the cantaloupes in the Imperial Valley, and on the walnut trees of the coastal counties; this damage is considerable every year. There is considerable complaint against the damage done by birds to the milo crops and the apricots in both San Bernardino and San Diego Counties, where these crops are grown in small isolated areas.

School Vacations usually coincide with the need for the child's assistance on the farm. In Imperial Valley, however, climatic conditions make it imperative that the vacation come in the summer rather than during the season of the peak-load of farm labor. In the walnut sections, the opinion prevails that in many cases a vacation should be given at the time of walnut harvest, as the children are very efficient in this work, and it is light and clean labor. For this purpose, vacations should occur in October. Some opinions indicate that the vacation normally coming at Christmas could better come in October in this emergency, as the vacation at Christmas time is practically useless so far as farm labor is concerned.

II. CENTRAL COUNTIES

(*Including all of the San Joaquin Valley*)

By B. H. Crocheron

Crop Indications.—The grain crops of wheat, barley, and oats will evidently be low during the present season. The acreage has increased some ten to twenty per cent in most counties, but the condition is poor, induced by the long, cold winter and by the lack of the normal amount of rain. The condition of the crop was poorer in the lower part of the San Joaquin Valley, outside of the sections where irrigation is practiced. In irrigated regions the grain crop appeared to be normal. Apparently in some counties more effort had been used to increase the acreage of wheat than that of barley. Evidently, all sections of the counties that could be easily sown to grain had been planted during the past winter in response to the high prices of grain in the market.

Fruit conditions were normal, or slightly above normal, in the five northern counties of the San Joaquin Valley, but in the lower part of the valley were far below normal. Indications were for a poor crop of deciduous fruit south of Fresno.

Summer crops, such as sorghums, beans, rice, corn, sweet potatoes, sugar beets, melons, etc., will undoubtedly be greatly increased. In many cases these increases range from 100 to 500 per cent, planted. This results from plantings in young orchards and vineyards and by sowing second crops on irrigated land. What the yields of these summer crops will be is yet too early to determine, since many of them are only now being sown, or in some cases the land is being prepared for later sowing. Shortage of seed is a serious consideration in many places where the farmers are unable to learn readily where supplies of seed can be obtained. In general, the high price of seed was not the ruling factor, but rather the lack of knowledge of definite places where the exact kind of seed could be had at a known price. Many local seed houses were entirely exhausted of their supply of feterita, milo, and other sorghums, as well as Tepary beans, Blackeye beans, etc.

Replanting.—Except in certain sections where irrigation was possible and where sub-irrigation prevailed, in the delta regions or close to rivers and sloughs, it was too late and the rainfall had been too deficient to plow up poor stands of grain for planting of sorghums during the present summer. No considerable acreage appeared where this practice could be advocated.

Intercropping.—There appear to be about 45,000 acres of young orchards and vineyards which will be intercropped during the present season with summer crops, such as grain sorghums or beans. Much of this land was apparently going into beans because of the high price of that product. In many cases it was in areas where beans had not previously been extensively grown. It appears doubtful whether beans will be always successful or whether the owners of the land fully understand the culture of that crop. It would doubtless be to the advantage of the food supply of the state to advocate the planting of grain sorghums more extensively where beans are now contemplated, except in cases where bean culture is thoroughly understood and where the farm practise is established.

Extension of Irrigated Areas.—In some of the more northern counties of the San Joaquin Valley, it is possible, in certain sections, to extend the area of irrigated lands. This will probably not result during the present season, since the land must be leveled, and in many cases the capital is lacking to undertake that work. For example, in the Turlock irrigation district it was estimated that there were 70,600 acres of irrigable land under the ditch for which water was available, provided the land was leveled. Settlers moving into that region had funds for the leveling of only a part of their land and had maintained a practise of leveling additional acres as funds were available. The 70,000 acres now unleveled and unirrigated represent the balance of the area. If means could be found to furnish capital to these settlers so that they, or agents for the irrigation district, could level that land, a considerable area would at once come under cultivation.

Farm Labor.—In general, labor appeared to be sufficient for immediate needs. Grave apprehension was felt, however, that later in the season there would be a great shortage of the usual itinerant labor. The practice and the plan has been to gather up in small towns bands of men to go about for harvesting work, picking of fruits, etc. If this itinerant labor should be lacking because of the army draft or because of higher wages in other occupations, there would be a very serious and immediate lack of farm labor in the San Joaquin Valley during the latter part of the summer. The number of itinerant men employed at the time of the "peak load" varied from 400 to 6000 men per county. Unfortunately, the "peak load" seems to occur about the same time over the entire San Joaquin Valley, namely, during the months of August, September, and October, the highest peak being about September 15th. Unfortunately, too, the schools have in the past gone into session sometime between the 1st to the 15th of September. Throughout the entire San Joaquin Valley, except in Kern County, it was felt that the postponement of the opening of schools to a month later would materially assist in meeting the labor situation, since much work done is of such character that it can be undertaken by children in the upper grammar grades and in the high-school classes.

Farm Animals, Supply and Condition.—In general, the supply of farm animals is at present almost normal, but the conditions of these animals is poor and evidently will become poorer still, due to the shortage of pasture and the high price of feed. Pasturage appeared to vary between 30 and 60 per cent of normal; probably not more than half the usual pasturage being available during the present season. It is expected that large numbers of cattle and hogs will be marketed owing to an immediate shortage of feed. In the lower San Joaquin Valley large numbers of hogs have been sold out during the late winter and spring owing to the shortage and high price of feed and the failure of the early alfalfa, resulting from the cold weather. This condition is equally true of poultry, since the poultrymen who purchase feed are unable to cope with the high price of grain, and are selling off their flocks very rapidly. Every possible effort should be made to warn ranchers that high prices for animals and animal products will obtain indefinitely and that they must maintain their breeding stock regardless of cost for feed. Undoubtedly the large crops of sorghums will later help out the situation. Because of the very late and cold spring, it was generally felt that one cutting of alfalfa had been lost; where five cuttings are usually made, growers believe they will obtain but four; where four cuttings are usual, probably only three will be secured. This will have an enormous effect upon the animal carrying-capacity of the San Joaquin Valley. Everywhere the opinion prevails that silos should be largely built by farmers who can afford them and that their use would greatly benefit the dairymen and stockmen. Undoubtedly, the silo has become popular in the San Joaquin Valley. Silo campaigns can well be promoted in all counties from Stockton to Bakersfield. In Stockton and Modesto the town garbage is used to fill in land. In both cities the authorities were requested to pass an ordinance requiring householders to separate the garbage from other waste products in order that it might be fed to hogs. Straw is finding a wider use for feed than it formerly had and in all sections where the farm area was small and the population dense, straw appears now to be used. In counties where large grain areas exist the straw is still being burned; this practice, however, appears to be dying away.

Making Farms Self-Sustaining.—In general, it appears that about 50 per cent of the local supply of vegetables is raised, the rest being imported from special vegetable growing regions. The restraining factor is often the scarcity of water, so that ranchers cannot successfully grow vegetables in competition with specialized vegetable growing regions, or more often it is generally accepted that a vegetable garden is not worth bothering with. Undoubtedly propaganda should be made to try to induce ranchers to maintain a family vegetable garden. In many cases flocks of chickens or one or two brood sows are not maintained on the ranches. This can be increased by public attention being called to their value in the present crisis when high prices for food products are prevailing. A general campaign of effort to make farm homes supply the needs of the farm family will in the present state of public opinion have a good effect upon the farm population and should be promoted in every way possible.

Better Use of Irrigation Water.—In many sections the irrigation companies have difficulty in delivering sufficient irrigation water after the middle of the summer. The irrigation companies claim that this is due to the lack of conservation on the part of the farmers, who use more water than is necessary, and that this in turn creates a water shortage. It is undoubtedly also true that water storage should be increased. It appears that the snowfall in the Sierras has been low during the past winter, and that although this water supply has been held in the mountains until the late spring, there will, nevertheless, be a serious shortage in some districts during the present season.

Due to the recent decision of the State Railroad Commission, companies supplying power for pumping are collecting bills closer than in the past, and many farmers find themselves unable to pay their power bills or their fuel bills for distillate and other oils used to run engines until the end of the season, when their crops give them money in hand. The companies, meanwhile, are insisting upon a thirty-day payment of purchases, and many idle pumping plants result. For example, in Tulare County the Mt. Whitney Power Company reports that they have an actual census of 216 gas engines of over 2000 total horsepower now not in operation, and that there are also 161 motors, totaling over 1500 horsepower, which are not connected with their power lines. The representatives of the company, however, were unwilling to state whether or not it was due to the more close collection of bills which is now practiced by that and other companies. An extension of credit for the purchase of power and for the purchase of fuel oil is needed in these areas.

Conclusions.—The general situation in the San Joaquin Valley is somewhat depressing, due to the weather conditions which have prevailed during the past winter and spring. These, however, being beyond control, can merit no more than passing mention.

The bad weather conditions may be offset by the fact that farmers are doing everything possible with their present knowledge and resources to increase the area and yield of crops. They realize generally that higher prices will prevail and that this is an opportunity to make unusual profits. There also is undoubtedly a widespread impulse to assist the nation in every way possible and to attest their patriotism by increasing the food supply of the state. Their limitations, however, are acute because of a lack of funds in hand or credit obtainable to extend farm operations. They are also restrained by fear of a labor shortage which will be so serious as to prevent the harvest of the crop.

GENERAL RECOMMENDATIONS

(1) *Finance.*—There are undoubtedly farmers who are unable to obtain sufficient credit, due to the fact that their farming was started on a "shoestring" as new settlers and they have not yet been able to obtain sufficient capital to extend their credit. While their local bank has sufficient funds, and is desirous of extending credit so far as possible, it is limited by the banking laws and the wisdom of not taking undue risks. It is highly desirable that a considerable sum of money be set aside by the state or some philanthropically inclined persons whereby farmers without banking credit who are approved by some state or federal agency on the basis of the quality of their land and the character and knowledge of the operator, could obtain loans upon unendorsed personal notes or upon their promise to pay at the time of harvest.

(2) *Labor.*—Some central organization should exist in each county whereby the labor needs of the farmers may be codified. These needs may be cleared through other agencies at local or distant points whereby available, itinerant, competent farm labor could be gathered together and presented for the needs of the farmers. It was quite apparent, for example, that in the San Joaquin

Valley during the late summer months unusual labor demands will be made this year to harvest the greatly increased acreage of summer crops. These labor demands drop off sharply at the end of October or beginning of November, when thousands of laborers would be available for transportation to Imperial Valley, for example, for the harvesting of the cotton crop. A county farm bureau which employed a labor clerk could catalogue all demands for laborers from farmers and should be able to present the labor needs of the county in such form that it could be met by labor-collecting agencies in the large cities.

(3) *Information.*—A more intensive system of supplying farm information to ranchers is needed in all parts of the San Joaquin Valley. The present farm adviser system should be extended and intensified to embrace all types of information to farmers which could have a direct bearing upon the growing of crops. For example, farmers should be supplied with immediate information regarding the purchase of seed; the exact methods of planting new crops; the best varieties of grain sorghums to plant; the methods of harvesting beans; the erection of silos; the growing of silage crops; the use of garbage; the feeding of straw and other by-products. They should also be informed of the probable trend of markets, the current prices, the best methods of marketing their products, the type or condition of the product that the market wanted, and similar information. Undoubtedly in most counties of the San Joaquin Valley one farm adviser and four or five assistants could be kept busy throughout the entire season giving a real informational service to the growers.

III. SOUTH COAST COUNTIES

By W. T. Clarke

San Mateo County.—The great handicap in this county is to be found in unoccupied, undeveloped subdivisions of land that are of high agricultural value. There are from ten to fifteen thousand acres of land on the bay side of San Mateo County, and some five thousand acres on the ocean side of the same county, which could be used for intensive agricultural work, providing labor were available to handle the lands in question. It was brought out in the inquiry that for proper agricultural work in San Mateo County about one man to seven acres is necessary. The county is a big producer of certain truck crops, notably artichokes, cabbages and cauliflower. Unless the labor is furnished, the acreage heretofore mentioned cannot be developed. The school-vacation periods are so arranged as to make the young people's work of most use to the farmers.

Santa Clara County.—Investigation showed that it requires for the ordinary working in this county, about one man to twenty acres, throughout the year. For the peak load of labor in July, August, and September, greatly increased forces are necessary, meaning by this term "greatly increased," about one man, boy or woman to two acres; this in handling the fruit in the orchards, in the drying yards, and in the canneries. This labor supply is not handled locally, but must come in from abroad. The interesting fact brought out was that while San Jose, the largest town in the county, has arranged its school vacations to meet the labor demands, the country schools as a rule have not so arranged their vacation periods, and as a consequence the country school labor supply is not available at the time when most needed, that is, in the fruit season.

This condition can be readily overcome if the school trustees choose to take action.

San Benito County.—The interesting fact shown in this county was that a considerable acreage could be placed under irrigation, providing it were possible for two electrical power companies to operate in the county. There are two power lines across the county at the present time. Only one of these power lines is, however, permitted, under the State Railroad Commission rulings, to operate there. Since the investigation, arrangements have been made by the Railroad commission to permit the use of power from the non-operating company in this county. If this is finally consummated it will mean the addition of many hundreds of acres to the irrigable area in that county for 1918. The same question of labor that arose in the previous counties noted is also found here. The county is a large producer of seed and also of sugar beets. Orientals are used in this work. Also, during July and August, from 500 to 800 white campers are used. The local supply is barely enough to meet the ordinary demand and does not meet the peak-load demand. For development in this county, under the intensive cultural methods there used, it requires one man to each ten acres to properly carry the crops.

Santa Cruz County.—Generally speaking, conditions of crops in the county are thoroughly good. The labor in the county is sufficient for present needs. It would require some three thousand men to develop fully the agriculture of this county. There are some ten thousand acres of land in Santa Cruz County that could be irrigated by the use of gravity ditches and by pumping. The labor situation here is bad, and any increased cropping presupposes a development in the labor forces.

Monterey County.—The same problem of needed labor supply was evident also here. The county requires about a thousand extra hands during the beet harvest, and these hands are usually supplied by floating labor, campers, etc., though there are a number of Japanese, Filipinos, and Hindus working in the county. Increase in agriculture in the county will depend upon the increase of the labor supply. In this county also there are two power companies serving the needs of the county, and serving them well. It developed in the inquiry in Monterey County, that the common bush rabbit and cottontail rabbit were doing an immense amount of damage, and resolutions were passed by the people assembled, requesting a modification of the protection of these creatures so that their numbers might be materially reduced and the losses caused by them reduced.

San Luis Obispo County.—In this county there are about 175,000 acres of land which are not now used under intensive agricultural work because of difficulties in transportation. This land lies in the neighborhood of Cholame and Shandon, and would not be usable until road systems are developed which would make it more readily accessible. The tract could be used in 1918 and afterwards if roads were provided. The county is fairly well supplied with labor, though there is not enough to carry the peak load. This has to be done by outside help, but is fairly well taken care of at the present time by campers and through city employment agencies.

Alameda County.—The high light points in this county were again the matter of labor to carry the "peak load," and also necessary additions to the regular labor force to increase agricultural production in the county. Generally speaking, the conditions are normal, though there is undoubtedly evidence of a falling off in stock production, owing to the earlier overstocking of certain of the ranches.

Contra Costa County.—In the words of one of the people in attendance, the labor situation seemed to be about this: "If we sell our products for better prices we do not begrudge paying labor more money, but we cannot see where the summer help in sufficient quantity is to be had at any price. Something must be done." The labor situation seems to be acute in this county. The Oriental is leasing orchards and is not available as formerly for farm work. There will undoubtedly be heavy losses in truck crops and in the fruit in this county on the rich delta lands if the labor problem is not solved.

San Francisco County.—The fact was brought out that there was a very considerable amount of labor available in San Francisco and in our other larger towns, providing this labor could be placed directly in touch with the demand in the country districts. A feeling of uncertainty, however, was expressed as being prevalent among those who sought work. They did not seem to be able to get into touch with the work in the country.

Summary.—In all of the counties visited the fact was brought out that ample capital was available and could be obtained by individuals desiring to use that capital for crop development. There is no tendency apparent, at least on the part of the banks, to hold back credit. The usual precautions as to security, of course, are demanded, but no unusual demands are being made and the person who is a good risk can have all the capital necessary on short notes for agricultural work.

The survey emphasizes the very pressing necessity of a fuller development and classification of the work offered in the country, and a fuller development of the forces seeking labor from our centers of population. Some form of getting the employer of labor and the worker in touch with one another is absolutely necessary, and because of the facts observed in the survey, the suggestion is offered that the labor forces, both adult and youth in our cities, be tabulated and classified so that it will be possible to get into touch with this labor readily, and that the labor demands in the country districts be also thoroughly canvassed through some central agency, so that the laborer and the employer may be brought together. This would necessitate studying the situation very carefully, both in the city and in the field, so that both the employee and the employer would be thoroughly protected. It would be possible to use the high-school teachers throughout the state as developing forces in getting at the supply of labor in the cities and towns, and where counties are supplied with county farm advisers it would be possible to get this labor supply in touch with the demand very readily. Where such organization as are under the control of the farm advisers do not exist, new organizations could be developed which would bring about this connection.

It is very evident that the farmer, both from patriotic motives and also from a knowledge of the fact that good prices may be expected for farm products, is doing his best, under the climatic and soil conditions prevalent, to bring about heavy production of crops. It is also evident that without more man power he cannot obtain the best results.

In the counties visited, the matter of the use of the tractor is as yet of minor importance. It is true that there are certain sections in the Salinas Valley where some of the work can be done by tractors. However, those sections are well supplied with tractors. The main work is intensive in its character, requiring careful labor with the hoe and other such implements, and unless man power is developed in these counties, agricultural development cannot be greatly increased.

IV. INYO COUNTY

By V. C. Bryant

The general conditions of this county are somewhat below normal at the present time, owing to the late spring and the hard winter which has just passed. In general, the county cannot be considered as an intensive agricultural locality. There are a great many crops, such as potatoes and beets, that could be produced in this locality were it not for the fact that freight rates are too high to enable the producer to ship them out at a profit. One thing that would stimulate the agriculture of this locality very much would be to reduce freight rates upon agricultural commodities or secure some special rates as, for instance, a potato rate, fresh-fruit rate, etc.

Crop Indications.—The indications are that the acreage of potatoes, wheat, and sugar beets will be increased this year. Other crops are about normal or a little below normal, owing to the lateness of the spring.

Replanting and Intercropping.—There is practically no replanting to take place in this county that can be observed at the present time. The spring crops are not as yet planted and it remains to be seen whether or not replanting will be necessary with these. The young orchards in this county are for the most part intercropped, but the acreage of these is not large.

Extension of Irrigated Areas.—It is estimated that there is water enough in this valley to irrigate between 150,000 and 200,000 acres, whereas, at the present time, only about one-half of this amount is being irrigated. If some systematic distribution of the water, under some constituted authority, was put into force, a great deal of land which is now producing sagebrush could be converted into alfalfa fields and other fields of production.

Drainage.—There are about 50,000 acres of land in Owens Valley that are badly in need of drainage. A high percentage of this acreage is now being used for pasture purposes, whereas, if it were properly drained, it would make very fine farming land.

Farm Labor.—Owing to the activity of the mines in Inyo County, the supply of farm labor is very scarce, and a committee has been appointed to get into touch with the various farmers of Inyo County and secure from them accurate information as to the amount of labor needed and the time when needed. When this information has been assembled there is a possibility that this committee may call upon the State Council of Defense to put them into touch with a source of labor.

Machinery and Seed Supply.—There is plenty of farm machinery available to work all of the lands that are under irrigation and can be worked with profit in this county at the present time. The available supply of seed potatoes and seed beans is somewhat limited, and the particular variety (Red Kidney) of beans which does the best in this county can scarcely be secured. Aside from potatoes and beans, there seems to be a sufficient quantity of seed available.

Capital.—There is plenty of capital available at local rates of interest (7 to 10 per cent) to carry on the normal agricultural operations of the county.

However, the drainage conditions might be improved and more land might be cleared and put under irrigation if there were a greater supply of capital at a reasonable rate of interest. As previously suggested, the acreage of this county could probably be doubled by making a more extensive irrigation system and by practicing a more judicious use of irrigation water, together with some drainage. To do this would require considerable capital.

Pasture Conditions.—The pasture conditions are below normal at the present time, owing to the lateness of the spring. A good share of the sheep and cattle are pastured on the national forests throughout the summer, and a good deal of this forest range is not in Inyo County, but is in Mono and other bordering counties.

Livestock is by far the greatest agricultural product of this county. There is some dairying throughout the county. According to estimates there are about 20,000 head each of cattle, sheep, and poultry, 3100 hogs, and 4500 horses. Last year 176,600 pounds of butter were exported from the county and about the same amount was consumed within the county. The stock is in poorer condition than it has been for many years, probably about 15 per cent below normal.

It is the opinion of the forest rangers of the Inyo National Forest that by expending a few thousand dollars towards installing additional watering troughs, making a few new trails and by seeding some denuded areas, the carrying capacity of these ranges could be very materially increased. This is especially true of the sheep ranges. It is recommended that these ranges be improved in this time of need.

Land for Summer Fallow.—There is no land available for summer fallow in this locality, owing to the fact that the rainfall is not sufficient to make dry farming profitable. All the tillable land must be irrigated.

Vegetable Supply.—About one-half of the vegetables used in Inyo County are shipped in. It would be possible to supply the greater amount of these locally should the people desire to do it. There is room for some campaign work along this line.

Crop Pests.—There are no crop pests in this county which do appreciable damage.

School Vacations.—School vacation comes at a time when the boys are of the greatest service to the farmers. The vacation period is from the first of June to the first of September.

V. EASTERN COUNTIES

By W. L. Howard

Conditions in all of these counties are very similar, in that the chief industries are mining and grazing. Farming, as a business, has been given little attention except in a few of the larger valleys in the lower foothills bordering on the San Joaquin Valley. The people as a whole, whether they live in town or country, buy nearly everything they eat. While this is not literally true, as home gardens and isolated fruit trees are widely distributed, they are not as numerous as they should be. Poultry are scarce, as well as hogs, sheep, and milch cows.

Before the output of farm crops can be greatly increased, water for irrigation purposes must be provided. Also the small farmer must be assured of a market for what he produces, as many can ill afford to buy seed at the prevailing prices unless they are practically certain of a ready sale at prices commensurate with the cost of seed.

Range feed everywhere was reported so short that cattlemen declared they would be fortunate if they were able to finish off 50 per cent of their cattle holdings. Without exception, the big cattle owners had little hope of being benefited by the prospective increase in summer forage crops that might be grown this year. It was their belief that they would not be able to pay the prices for feed that would be demanded by the valley farmers. However, it was agreed by all that the small ranchers might find ways of growing enough feed to enable them to provide their families with both meat and milk, neither of which is now produced in sufficient quantities to supply the rural communities and small towns.

These counties afford a fertile field for missionary work along the line of increased crop production from tilling the soil. The citizens of Calaveras County evinced an especially keen interest in learning how to grow summer forage crops, such as the grain sorghums and Sudan grass. Everywhere there was a great willingness to learn about the new crops and how to grow them. Local committees were appointed in each of the counties for the purpose of continuing the agitation for increased food production, and with a little assistance from the state and national government, undoubtedly much good will be accomplished.

Crop Indications.—While the foothill or mountain country is not a grain- or alfalfa-growing region, these crops are produced in all of the counties to a limited extent. Amador is perhaps the largest producer of grain and forage crops. There barley, wheat, and oats are grown chiefly for the grain, while in the other counties they are produced chiefly for the hay. On the whole, the grain acreage is normal to a little above, while the condition was reported to be from 10 to 20 per cent below normal on account of shortage in spring rainfall.

Replanting and Intercropping.—The acreage of grain in poor condition that could be plowed up and planted to summer crops was reported to be very limited. In a few instances this might be done if irrigation water were available.

There are practically no orchards that can be intercropped, as orchards are scarce except at high elevations and irrigation water is not available. A small acreage might be intercropped without irrigation.

Extension of Irrigated Areas.—Very little land in these counties is now under irrigation, but the people were nearly unanimous in their belief that the irrigated area could be extended, particularly in the Jackson, Ione, and Shenandoah valleys in Amador County, where 5000 acres or more could be watered by diverting water now used for power purposes. In Calaveras County there are extensive ditch systems which could be utilized at a comparatively slight expense by water secured from the Mokelumne River.

Farm Labor.—In the main there was to be found enough help to take care of such crops as are being grown, but if the crop acreage is to be increased, extra help in proportion will be needed. Nowhere was there found a surplus of farm labor. The time of peak load ranges from May to September, depending upon the kind of crops grown.

Machinery and Seed Supply.—Little shortage of farm machinery was found, although in a few instances more grain-harvesting outfits and threshers are needed.

No one reported stocks of agricultural seed on hand. Because of the fact that seeds of all kinds appear to be purchased each year as needed, owing to the present high prices many small farmers are barely able to plant in a small way and wholly unable to increase their plantings.

Capital.—Money was reported plentiful by the big ranchers and scarce by the little ones. It was apparent that many earnest, hardworking settlers need financial help if they are to increase their crops.

Pasture Conditions.—The carrying capacity of pastures was found to be 25 per cent to 50 per cent below normal. This was attributed to the scarcity of rainfall during the spring. In some sections, particularly in Tuolumne County and in Mariposa County, the grass came up as usual, but on account of the dryness of the soil it began to turn brown when yet too short for grazing.

Resolutions were presented at meetings held in Tuolumne County, also in Mariposa County, asking that that part of Yosemite Park north of Yosemite Valley be opened up to grazing during the present season. It was estimated that this extra range would take care of about 10,000 cattle or their equivalent in sheep. This request has since been granted by the Department of the Interior.

Land for Summer Fallow.—Thousands of acres of grass land that could be summer fallowed were reported throughout the district. Since comparatively little farming has been done heretofore it is unlikely that much will be done this year in order to promote heavier crop production in 1918, unless local committees or other agencies continue to carry on a vigorous agitation. If farm advisers were available in each of these counties, or even if a man could travel from county to county and constantly advise with the farmers during the present season, there is no doubt but that crop production could be materially increased in the near future.

Live Stock.—The number of live stock on hand was reported as normal, but their condition is somewhat below normal on account of the shortage of range which left the stock in bad condition. It was believed that the number of cattle could not be materially increased because of the lack of feed. Stockmen were unanimous in saying that without more feed they could not hope to finish off more than half their present number of cattle. There appears to be no waste of straw, all of it being used to feed live stock.

There seems to be an opportunity for the agricultural organizations of the valley region to get busy and either purchase half-finished cattle and finish them off with feed that will be grown this summer, or make arrangements for selling their grain and roughage to the cattle owners of the mountain regions at reasonable prices. In this connection the cattle owners ought to be urged to fatten their cattle at an earlier age than they have been doing in the past. It was conceded that silos would increase the live stock carrying capacity of the counties, and building material for either wood or concrete silos seems to be abundant.

It was very apparent everywhere that poultry and rabbits could be very greatly increased, perhaps by a hundred per cent. Many objected to this suggestion because feed is too high-priced to permit of buying it for growing poultry. However, it was pointed out that there is scarcely a farmer that could not produce enough grain sorghum, sunflower seed, and alfalfa to feed perhaps several hundred head of both rabbits and poultry. While rabbits will thrive on alfalfa, both green and dry, the flesh is not firm enough to command a good price in the open market unless the animals are finished off on grain of some kind.

Vegetable Supply.—Only 10 to 25 per cent of the vegetables now used in the mountain counties are grown locally. There is a vast field here for growing vegetables, not only in order to feed the population of the towns, but to take care of the large number of men employed in the mines.

The country in this section is not well adapted to growing large areas of vegetables in one place, but there are plenty of opportunities for growing such crops in special localities even though the plots might be comparatively small. In every community enough water could be found for irrigating small gardens.

Crop Pests.—No bad crop pests were reported except gophers and squirrels.

School Vacations.—In general, school vacations now occur at a time when the children are most useful on the farm.

VI. NORTH COAST COUNTIES

By T. Francis Hunt

Crop Conditions.—Since the north coast counties are not heavy producers of hay or cereals, the condition of these crops is of little importance. The acreage of these crops in Napa, Marin, and Sonoma counties is about normal, but the condition of the crops is poor. In the northern counties recent rainfall has made the outlook for these crops at least normal. The fruit outlook is reported above normal in every county. This is of particular importance in Napa, Sonoma, and Lake counties. Indications are for a heavy crop of prunes, apples, and pears. The trees have blossomed very heavily this spring. The good prices of these crops during the last few years have had the effect of making the growers more careful about the proper handling of the trees so that, as a rule, the trees are in better condition than normally and there should be a very heavy crop, barring unforeseen accidents.

Pasture conditions in the southern counties of this group are reported as only 50 to 60 per cent of normal. The winter weather conditions have been unusually bad. The winter was cold and the rainfall not only comparatively light, but it came in such a way that it did not help the pastures as under ordinary conditions and, as a result, the pastures are in an extremely bad condition. In the section north of Mendocino County where the pasture has been poor until recently, everyone seemed to be optimistic in regard to the pasture conditions for the remainder of the season.

The summer crops grown in this region are normally of little importance. Reports show a considerable increase in the acreage of corn, beans, and potatoes. While enthusiasm in regard to planting these crops is manifest and there is every indication that there will be considerable increase in the acreage planted, the total yield will not be such as to influence the food supply in the state as a whole.

Live Stock.—Beef cattle have come through the winter in poor condition and the general report was that herds would have to be reduced materially this fall on account of scarcity of feed. In some localities the cattle are unusually thin and would require very favorable weather and good feed to put them in condition.

Dairy cattle for the most part are in fair shape. Because of the high price of dairy products the dairymen have purchased mill feeds and alfalfa so that their herds have come through in very good condition. There is much discussion in regard to reduction of herds because of the extremely high prices of hay and concentrates and because of the difficulty of getting milkers.

The stock of hogs is extremely low, in most places being 50 per cent of normal. In a few small localities, the stock of hogs has been practically sold off because of the high price that has prevailed during the last year or so. Although this condition is true in certain localities, the general indications are that the stock would be reduced considerably further because of the high price of feed.

The supply of horses and mules is sufficient for farming operations. There appears to be a scarcity of horses that might be available for cavalry purposes. It was difficult to get a fair understanding as to the number of this type of horses because there seemed to be a great deal of difference of opinion as to whether or not the horses available would come up to the government specifications.

Farm Labor.—Farm labor was invariably reported insufficient. In two counties, Napa and Sonoma, the shortage of labor will be acute during the fruit-picking season and much can probably be done in securing labor, largely family labor, for these counties from June to September. In the other counties the lack of labor is not so seriously felt, although many farmers are looking for additional men and help is hard to secure.

Farm Machinery.—No serious lack of farm machinery was apparent in any county. In a number of the counties it was thought that additional tractors could be used, but there seemed to be no definite plan or any definite piece of land upon which to put these tractors. It may be safely said that if present conditions continue for another year or more, about twice the number of tractors could be used in these counties to advantage. In these counties, if the bean acreage continues to increase, as appears probable, the need for small bean thrashers will be very great, but it would seem that there will be ample time to supply this need.

Finances.—In this section of the state there is plenty of capital available locally to finance farming operations. However, a feeling was noticeable to the effect that production could be increased if there were some capital available to aid farmers whose security was none too good. In other words, there are many honest, hard-working farmers who could put in additional crops if they could be supplied with capital, while their security is of such a nature that it would be difficult to get the ordinary banking laws to cover them. It was hinted on numerous occasions that the state or federal government could well finance many of these farmers who are having some difficulty in getting capital to increase production.

The supply houses have their normal stock of cans and fruit jars or have contracted for them to be delivered and do not fear any shortage in this regard.

Recommendations.—The committee felt safe in recommending in every county greater effort to produce feed for live stock and that throughout the entire section the use of the silo could be extended to great advantage. There is no doubt but that the building of silos throughout all the northern coast counties would materially add to the live-stock carrying capacity of the section.

There are great possibilities, particularly in Mendocino, Humboldt, and Lake counties in raising of both potatoes and beans. These counties are not particularly well adapted to the growing of summer crops which require considerable heat, but both beans and potatoes do very well and other growth could be increased markedly. In these counties there are possibilites of increasing the production this year. We also feel safe in recommending the use of better stock. This applies particularly to hogs.

VII. NORTH CENTRAL COUNTIES

By H. E. Van Norman

Extension of Irrigation Areas.—Some steps should be taken to make available water in Placer and El Dorado counties. In both counties the general opinion was that the price charged for water is too great to permit of its use on the emergency crops. This matter should be taken up with the Western States Electric Company in El Dorado County and the P. G. & E. in Placer County.

In Placer County there is for this season a considerable amount of water going to waste below the power plant of the Pacific Gas and Electric Company, which could be diverted along the line of the stream and made available for the growing of crops east of Lincoln. Eventually, all this water will be used in ditches that are now under construction. The company said it could be diverted this season without any expense except that which would be incurred by the ranchers using the water, and local diversions can be made without prohibitive expense.

Colusa County reported a large area along the rivers which might be irrigated by pumping from the river and planted to a second crop.

Labor.—Rice growers anticipate a shortage of men and teams, also harvesters to properly handle their crop. They have tried to hire teams from outside districts. They complain of the inefficiency of the teams, and yet when we get the other side, we are told that the rice harvest is very hard on men and teams, and owners are unwilling to rent teams for rice harvesting because of the severity of the work.

In every county on the floor of the valley there was a demand for the universal closing of saloons to increase the efficiency of the present labor supply, by eliminating the loss due to the men laying off from one to several days after each pay-day, even though they come back to work after they are sober. It was also expressed that this would even bring a large proportion of the hobo class to work. There was a very insistent demand in several counties for some legislation or plan that would put to work the large number of men idling along the railroads who will not work when a job is offered to them, and yet they prey on the communities through which they move.

Butte County reported some land with water available by pumping, pumps and motors installed, which would not be cropped this season for want of someone to do the work.

Tehama County reported a 50 per cent decrease in the hop acreage, with a corresponding release of labor for other crops.

Capital.—There are a considerable number of small land holders in all of the newer settled section who have used all of their capital and credit for the purchase of their land and in most cases inadequate equipment of it, who could grow more crops if the purchase of seed could be financed. The amount of money involved in individual cases is not large.

Solano reported that men who were known locally can borrow needed funds for seed with resulting crop as security.

In Sacramento County it was pointed out that many of the small settlers are poorly equipped; they have a meager supply of farm machinery, they have bought poor horses, and generally speaking, are not supplied with facilities for proper handling of the land which they have.

Glenn County reported a shortage of binders for harvesting rice.

Feed—It is estimated there will be 100,000 tons of rice straw available, which, in the opinion of a number of ranchers who fed it last year, is valuable feed for carrying cattle through the winter. Some systematic organized effort should be made to have this saved and to have it available for the carrying of stock which otherwise may be short of feed.

One of Butte County's prominent farmers said, "If I had had one ton of rice straw per animal in the short months, my stock would have come through the winter 100 per cent better.

In the bean-growing area of these counties there is considerable bean straw which has heretofore been wasted, that might be made available for the feeding of sheep, and to a lesser extent for the feeding of cattle.

It was brought out in many counties that barley straw is still burned in large quantities.

Vegetable Supply.—Without exception the counties report that they are depending largely or wholly on outside shipments of vegetables to supply local demands. In a few cases they report that the mid-summer demands are supplied locally.

It is suggested that some serious consideration might be given to methods of and plans for encouraging the drying of vegetables; possibly the kilns used for drying hops might be adapted to the drying of vegetables, as well as the possibility of sun-drying.

In the district tributary to Sacramento there is a noticeable increase in the acreage of tomatoes and spinach being grown for the Libby, McNeil & Libby cannery.

School Vacations.—There seems to be a general concurrence of opinion that if the school vacation could be prolonged to the first or middle of October in the fruit section, it would materially help the handling of late fruits.

Intercropping.—Butte County was the only one that reported a general practice of intercropping in orchards.

Silos.—There was an appreciable interest in the building of silos in most counties and apparently a growing recognition of their value.

Poultry.—There was a noticeable lack of any general raising of poultry. There are a few people engaged in raising Belgian hares in each county that we visited.

VIII. NORTHEASTERN COUNTIES

By G. H. True

The general character of the six northeastern counties of the state, with the exception of the southeastern part of Shasta county, which extends into the Sacramento Valley, is very similar throughout. The region as a whole may be characterized as mountainous and of an altitude such as to give a climate comparable to that of the mountainous states north and east of California, and more or less like that of the middle west. Trinity County seems to stand by itself as a non-agricultural region, mining being the principal industry, a few cattle (estimates vary from 2000 to 5000 head) being the only export credited to the county outside of the product of its mines. Trinity County as truly as the British Isles is dependent upon outside sources for its food supply.

Character of Agriculture.—Speaking generally for these counties it may be said that the range livestock industry is the principal one. The object of farming is to produce winter feed for the cattle on the range, and such supplies as are required by the mines of the region. While some wheat may be shipped out, it is safe to say that larger amounts of flour are bought on the outside. The counties do not produce either the pork products or vegetable supplies consumed.

Possible Extension of Agriculture.—The most important extensions to the farming areas in these counties are to be made as a result of the development of irrigation. Important developments along this line are under way in Siskiyou county, where 5000 acres will be put under cultivation in the vicinity of Montague during the present year. In Strawberry Valley it is stated that 3500 acres could be put under irrigation through the construction of proper irrigation systems, there being an abundance of water now unused. In Shasta County the Anderson Cottonwood Ditch now under construction is supposed to furnish water for 12,000 acres of new land, 3000 acres of which will be cropped this year. In Lassen County a project contemplating the use of water from Butler Creek will bring under cultivation some 7000 acres of land. Extension of cultivated area by dry-farming additions could be made in Lassen County by the plowing of new land in Honey Lake Valley, and possibly in the Madeline Plains, also by the development of low-lying lands in Big Valley in the vicinity of Bieber, where 8500 acres of land capable of yielding thirty bushels per acre could be plowed this year ready to crop next year if power were available. A few hundred acres could also be added to the cultivated area in Surprise Valley in Modoc County.

Live Stock.—The number of head of live stock throughout these counties is practically normal, the ranges being stocked throughout to their full capacity. On account of the past hard winter the surplus supply of feed for live stock on the ranches is completely wiped out, it having been necessary to ship hay into some of the remote regions at a cost of as high as $30 a ton to save animals from starvation. The season is at least a month late and while the indications are for good pasturage later, the outlook for the season as a whole is for less than a normal condition of pasturage. Spring crops had not been planted throughout most of the farming districts. On the whole, an increased acreage of grain was predicted but nothing could be said concerning the character of the crop.

The conditions for marketing live stock in Modoc County especially have not been satisfactory. During the last season there was but a single buyer in the field and but one price was offered. The cooperative system of marketing cattle whereby more satisfactory market conditions may be attained is needed.

Crop Pests.—The most injurious of crop pests seems to be the ground squirrel which is common throughout the whole region and injures grain crops to the estimated extent of 5 to 20 per cent. One man made the statement that his crop was injured to the extent of $1.50 per squirrel.

Power.—Throughout these counties there seems to be a sufficient supply of horse and mule power for the planting of this season's crops. In the region named, however, where there is a possibility of an extension of dry farming, this increased area would be brought under cultivation only through the use of power not now available. Detailed reference was made in our reports from the field to tractors in the vicinity of Susanville that might be available for certain months; also in Siskiyou County, of certain tractors now in use on the new irrigation project at Montague which might be available for certain parts of the year.

It is thought that in Modoc County 250 head of horses weighing around 1300 pounds would be available for purchase after the grass had grown sufficiently to give them an opportunity to get into good condition. It is thought that 2500 head of horses and mules could be bought in Lassen County.

Labor.—In Shasta, Trinity, and Siskiyou counties there seemed to be no shortage of farm labor. Plumas, Lassen, and Modoc will need something like 2400 men during the season for haying and harvest in July, August, and September.

Capital.—Local banks throughout the six counties seemed to have sufficient money to finance all farm operations. Conditions under which money is loaned, however, are not such as to make it possible for the poor farmer whose land is of questionable value on account of climatic conditions, limited rainfall and unseasonable frost, to borrow money sufficient to take the necessary chances in the matter of cropping. It would seem advisable that some steps should be taken to bring before these people the possibilities of the use of the Farm Loan Bank. It is desirable, first, that they should have the advantage of a low rate of interest, and second, a just valuation of their land by such agency would result in a very much needed stabilizing of land values in regions where colonization is being attempted. Reference is made especially to the Madeline Plains in Modoc County and Butte Valley in northern Siskiyou County.

Summary.—In summarizing the situation in these counties it seems that urgent necessities lie along the following lines:

First, that every effort be made to increase crop production in order that meat-making animals from the range may be carried through the winter not only without loss, but without serious deterioration in flesh. Further, that steers to a larger extent than is now the case may be marketed from the range, making it possible to carry a larger number of breeding stock.

Second, that the range sheep men be urged to give most careful consideration to the possibility of improving the conditions of lambing practice to the end that serious losses now experienced be lessened.

Third, it seems advisable to urge families to make every effort to produce the home supply of vegetables, no matter whether living in villages or on farms. Also that farm cropping be so balanced that the counties in question grow their own supply of wheat for flour locally.

Fourth, co-operation in the distribution of products raised is very much needed, so as to avoid the same product being shipped out from one part of the county into another or into another county. Co-operation in the handling of labor should also be given serious consideration.

OUTSTANDING CONCLUSIONS FROM AN EMERGENCY IRRIGATION SURVEY OF CALIFORNIA BY THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF CALIFORNIA CO-OPERATING WITH THE IRRIGATION INVESTIGATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, AND THE CALIFORNIA STATE DEPARTMENT OF ENGINEERING

ELWOOD MEAD AND FRANK ADAMS, *Committee*

Summary:

(1) From 1899 to 1912 the irrigated acreage in California increased from 1,466,000 to 3,200,000 acres, or at an average rate of 135,000 acres per year.

Owing to unsatisfactory land settlement conditions, this rate of increase was not maintained from 1912 to 1915, yet the indications are that 1917 has not only brought a return to the normal, but that the widespread interest in increasing food production and, more particularly, the present high price of agricultural products have resulted in a very considerable additional seasonal increase for this year, possibly as much as 100,000 acres.

(2) Although, in the main, unavailable for use until qualified agricultural settlers have been placed upon the land, canals and principal laterals are already constructed sufficient to add an additional half million irrigated acres, and construction is now under way or arranged for, and due to be completed within three years, that will make irrigation water available to 300,000 acres more.

(3) Legal obstacles standing in the way of a more complete use of irrigation water controlled by public service and mutual water companies and individuals have been removed by action of the California State Railroad Commission and a special enactment by the legislature. Owing to the irrigation season being advanced when the war emergency arose, however, resulting opportunities for increased irrigation through the use of this surplus water have not been largely seized in 1917.

(4) Reorganization and consolidation of existing irrigation enterprises, completion of irrigation works now under way, efforts toward temporary or permanent adjustment of local irrigation controversies, and more complete and more careful utilization of regular irrigation supplies, have been definitely stimulated by the war emergency. A spirit of unwillingness to subordinate individual nterests involved in pending controversies over the use of water to the furtherance of the national good unfortunately, however, is not altogether lacking.

(5) If, in some instances, during the war emergency there can be a temporary exercise of superior national or state authority to stop waste of flood waters kept out of use through local differences but without permanent or substantial loss to those responsible for the waste, the effective additions to the irrigated area in California can be still further increased.

Recommendations:

There can be no question of the patriotic effort of many farmers and land owners throughout California to increase the irrigated area during the war emergency, nor of the great stimulus that has been given to increased production under irrigation by the present high level of prices of all agricultural products.

No enthusiasm for this response, however, should becloud the fact that while highly commendable and advantageous, the irrigation increases during 1917 will be much less than would be possible if either state or national authority were so organized as to force utilization where there is now waste and furnish financial aid and direction where these are essential.

It is too early at this writing to ascertain the extent to which surplus water is being utilized in 1917 under the emergency order of the State Railroad Commission and the special act (chapter 191) of the 1917 legislature permitting emergency deliveries by mutual water companies and owners of individual irrigation plants. It is recommended, however, that the general extent of such use in 1917 be ascertained later in the 1917 irrigation season with a view to encouraging the extension of such use in 1918 if found practicable and beneficial during 1917.

It is further recommended that additional investigation be made by the proper agencies as to the extent to which the use of irrigation water can be extended in California in 1918 and subsequent seasons during the continuance of the war emergency, provided it is found desirable to establish and exercise such higher governmental authority as shall be found necessary to prevent waste and to force the temporary setting free, under conditions that will not jeopardize permanent rights, of all unutilized water that can be advantageously applied in irrigation during continuance of the need for maximum production.

Finally, it is recommended that the proper agencies continue the giving of advice and assistance to irrigators and irrigation communities in the practcal questions relating to the application of water to land and that every effort be made so far as lies within our means to insure that no irrigated land in California remains out of use during the period of the war through lack of information as to its location or as to feasible means of applying the irrigation water needed to make it productive.

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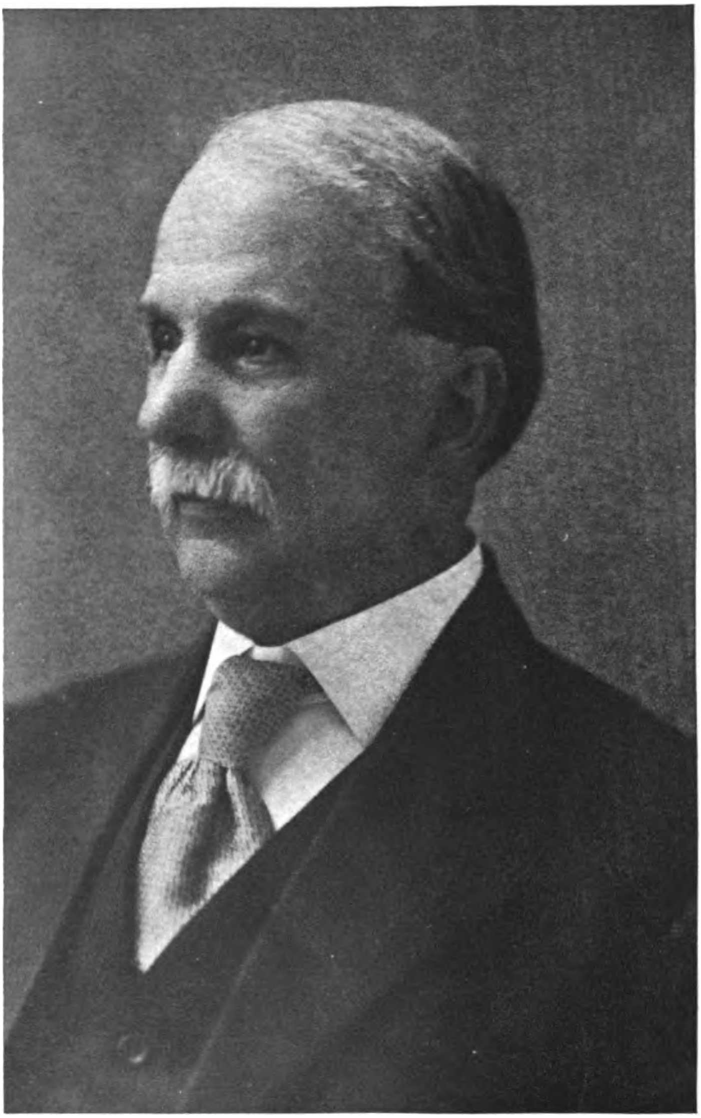

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E. J. Hauser, B.S., Assistant in Agricultural Extension.
F. M. Hayes, D.V.M., Assistant Professor of Veterinary Science, Davis.
Mrs. Jessica Hazzard, Assistant in Agricultural Extension.
W. H. Heileman, M.S., Assistant Professor of Agricultural Extension, Glenn County.
A. H. Hendrickson, B.S., Assistant Professor of Pomology.
G. W. Hendry, B.S., Assistant Professor of Agronomy.
§W. B. Herms, M.A., Associate Professor of Parasitology.
§J. P. Hertel, B.S., Assistant in Agricultural Extension, Imperial County.
P. L. Hibbard, B.S., Assistant Professor of Agricultural Chemistry.
Miss C. J. Hill, B.L., Assistant in Dairy Testing.
*F. E. Hill, Foreman Forestry Station, Santa Monica.
D. R. Hoagland, M.S., Assistant Professor of Agricultural Chemistry.
R. W. Hodgson, M.S., Instructor in Citriculture.
§V. W. Hoffman, B.S., Assistant in Pomology, Davis.
W. T. Horne, B.S., Associate Professor of Plant Pathology.

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*Resigned. †Leave of absence. § In military service.

W. L. Howard, Ph.D., Associate Professor of Pomology, Davis.
†W. G. Hummel, M.S., Associate Professor of Agricultural Education.
T. Francis Hunt, B.S., Assistant Professor of Agricultural Extension and Assistant Superintendent of Farmers' Institutes.
R. C. Ingrim, Instructor in Shopwork, Davis.
J. Jacobson, Foreman of Repairs, Davis.
M. E. Jaffa, M.S., Professor of Nutrition.
B. J. Jones, B.S., Assistant in Agricultural Extension.
Miss K. D. Jones, B.S., Assistant in Landscape Gardening.
A. A. Jungermann, M.S., Assistant in Agricultural Extension, Stanislaus County.
T. R. Kelley, A.B., Instructor in English and History, Davis.
W. P. Kelley, Ph.D., Professor of Agricultural Chemistry, in Citrus Experiment Station, and Graduate School of Tropical Agriculture, Riverside.
P. B. Kennedy, Ph.D., Associate Professor of Agronomy.
W. A. Kent, Assistant in Agricultural Extension, Stanislaus County.
O. J. Kern, Assistant Professor of Agricultural Education.
G. W. Kretsinger, B.S., Assistant in Agricultural Extension, San Diego County.
*G. C. Kreutzer, B.S., Instructor in Agricultural Extension, Kern County.
§P. E. Lantz, B.S., Assistant in Agricultural Extension.
E. J. Lea, M.S., Associate Professor of Nutrition.
M. A. W. Lee, B.S., Assistant in Agricultural Extension, Alameda County.
C. B. Lipman, Ph.D., Professor of Soil Chemistry and Bacteriology.
W. E. Lloyd, B.S., Instructor in Poultry Husbandry, Davis.
Miss M. Long, Assistant in Agricultural Extension.
W. A. McCutchan, B.S., Assistant in Agricultural Extension, Fresno County.
W. W. Mackie, M.S., Assistant Professor of Agronomy.
B. A. Madson, B.S.A., Assistant Professor of Agronomy, Davis.
*Miss Katherine Magneson, Assistant in Agricultural Extension.
J. C. Marquardt, B.S., Assistant in Dairy Husbandry, Davis.
D. E. Martin, B.S., Assistant in Agricultural Extension.
J. C. Martin, B.S., Assistant in Agricultural Chemistry.
§D. T. Mason, M.S., M.F., Professor of Forestry.
§H. A. Mattill, Ph.D, Assistant Professor of Nutrition
Mrs. H. I. Mattill, Ph.D., Instructor in Nutrition.
T. C. Mayhew, B.S., Instructor in Agricultural Extension.
Elwood Mead, D.E., Professor of Rural Institutions.
G. E. Merrill, B.S.A., Instructor in Agricultural Extension, Sonoma County.
*W. M. Mertz, Superintendent of Cultivations, at the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
Woodbridge, Metcalf, M.S., Assistant Professor of Forestry.
M. R. Miller, B.S., Assistant Chemist in Insecticide Control.
R. F. Miller, M.S., Assistant Professor of Animal Husbandry, Davis.
J. W. Mills, Instructor in Agriculture, Solano County.
J. N. Moore, Foreman, Forestry Station, Chico.
*D. N. Morgan, B.S., Associate Professor of Agriculture and Assistant to the Director.
J. G. Moodey, B.S., Assistant Professor of Agriculture and Assistant to the Director.
Mrs. D. J. Morris, B.D.S., Assistant in Agricultural Extension.
Walter Mulford, F.E., Professor of Forestry.
§F. T. Murphy, B.S., Assistant in Agricultural Extension.
C. S. Myszka, B.S., Instructor in Agricultural Extension, Mendocino County.
§A. N. Nathan, B.S., Assistant in Agricultural Extension.
R. E. Nebelung, B.S., Assistant in Agricultural Extension.
J. W. Nelson, B.S., Assistant Professor of Soil Technology.
Carl Nichols, B.S., Instructor in Agricultural Extension, San Luis Obispo County.
J. H. Norton, Instructor in Chemistry, Davis.
§W. D. Norton, B.S., Assistant in Agricultural Extension.
W. E. Packard, M.S., Assistant Professor of Agricultural Extension.
*W. B. Parker, M.S., Assistant Professor of Agricultural Extension, Riverside County.
*A. L. Paschall, B.S., Instructor in Agricultural Extension.
P. T. Peterson, D.V.M., Instructor in Veterinary Science, in charge of serum manufacture.
G. L. Philp, B.S., Instructor in Pomology, Davis.
W. T. Pope, B.S., Instructor in Botany, Davis.

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†Leave of absence. *Resigned. §In military service.

*M. B. PRATT, M.F., Assistant Professor of Forestry.
J. A. PRIZER, B.S., Superintendent of Cultivations, Riverside.
H. J. QUAYLE, M.S., Professor of Entomology, Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
W. R. RALSTON, B.S., Assistant in Agricultural Extension.
H. S. REED, Ph.D., Professor of Plant Physiology in Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
M. A. RICE, B.S., Assistant in Agricultural Extension, Kern County.
C. L. ROADHOUSE, D.V.M., Professor of Dairy Industry, Davis.
W. C. ROBERTS, B.S., Assistant in Soil Chemistry.
R. D. ROBERTSON, B.S., Assistant in Soil Chemistry.
J. T. ROGERS, Farm Foreman. Davis.
S. S. ROGERS, B.S., Associate Professor of Olericulture, Davis.
R. P. ROYCE, B.S., Instructor in Animal Husbandry, Davis.
C. W. RUBEL, B.S.A., Assistant Professor of Agricultural Extension.
Mrs. M. H. Schilling, B.S., Assistant in Agricultural Extension, Glenn County.
*RICHARD SCHMIDT, Orchardist of University Farm, Davis.
F. H. SCRIBNER, A.B., Assistant in Agricultural Extension, Los Angeles County.
N. P. SEARLES, B.S., Assistant in Agricultural Extension, Yolo County.
‡C. M. SIEBERT, B.S., Assistant in Agricultural Extension, Alameda County.
H. H. SEVERIN, Ph.D., Instructor in Entomology.
L. T. SHARP, B.S., Assistant Professor of Soil Chemistry and Bacteriology.
C. H. SHATTUCK, Ph.D., Professor of Forestry.
C. F. SHAW, B.S., Professor of Soil Technology.
ALFRED SMITH, M.S., Assistant Professor of Soil Technology.
C. O. SMITH, M.S., Instructor in Plant Pathology in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
Miss E. H. SMITH, M.S., Assistant Professor of Plant Pathology.
L. B. SMITH, B.S., Instructor in Agricultural Extension.
R. E. SMITH, B.S., Professor of Plant Pathology.
E. F. SMYTH, Assistant in Agricultural Extension.
A. R. SPRAGUE, M.A., Assistant in Agricultural Extension, Orange County.
W. H. STABLER, B.S., Assistant in Veterinary Science.
†R. T. STEVENS, B.S., Assistant Professor of Landscape Gardening.
G. R. STEWART, B.S., Assistant Professor of Agricultural Chemistry.
J. E. STILES, B.S., Assistant in Agricultural Extension, Sutter County.
E. C. SULLIVAN, B.S., Assistant in Agricultural Extension, Imperial County.
WALLACE SULLIVAN, B.S., Assistant in Agricultural Extension, Kings County.
‡ALFRED F. SWAIN, M.S., Assistant in Entomology in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
W. L. SWEET, M.S., Instructor in Pomology.
PARKER TALBOT, B.S., Assistant in Agricultural Extension, Shasta County.
THOMAS TAVERNETTI, B.S., Assistant Professor of Farm Practice and Assistant to the Dean of University Farm School, Davis.
R. H. TAYLOR, B.S., Assistant Professor of Pomology.
E. E. THOMAS, B.S., Assistant Chemist in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
Mrs. W. W. THOMAS, Assistant in Agricultural Extension.
†J. I. THOMPSON, B.S., Assistant Professor of Animal Husbandry, Davis.
F. G. TIFFANY, B.S., Assistant in Agricultural Extension.
J. E. TIPPETT, B.S., Assistant in Agricultural Extension.
C. M. TITUS, M.A., Instructor in Mathematics, Davis.
J. TRAUM, D.V.M., Assistant Professor of Veterinry Science.
G. H. TRUE, B.S., Professor of Animal Husbandry, Davis.
W. P. TUFTS, M.S., Assistant Professor of Pomology, Davis.
†R. S. VAILE, B.S., Assistant Professor of Orchard Management in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.
†E. C. VAN DYKE, M.D., Assistant Professor of Entomology.
H. E. VAN NORMAN, B.S., Vice-Director of Agricultural Experiment Station; Dean University Farm School and Professor of Dairy Management, Davis.
F. J. VEIHMEYER, B.S., Assistant Professor of Irrigation Investigations.

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*Resigned. ‡ In military service. †Leave of absence.

C. M. VESTAL, B.S., Assistant Professor of Animal Husbandry, Davis. (Exchange professor, Kansas Agricultural College, 1917–18.)

[3] E. C. VOORHIES, B.S., Assitant Professor of Animal Husbandry, Davis.

[3] H. A. WADSWORTH, B.S., Assistant in Irrigation, Davis.

R. M. WALKER, B.S., Assistant in Agricultural Extension.

H. L. WASHBURN, B.S., Assistant in Agricultural Extension, Santa Cruz County.

*H. M. WATKINS, B.S., Assistant in Agricultural Extension.

A. E. WAY, Field Assistant in Viticulture, Fresno.

D. D. WAYNICK, Ph.D., Instructor in Soil Chemistry.

H. J. WEBBER, Ph.D., Director of Citrus Experiment Station, Dean Graduate School of Tropical Agriculture and Professor of Plant Breeding, Riverside.

H. A. WEINLAND, B.S., Assistant in Agricultural Extension, San Diego County.

W. W. WEIR, Assistant Professor of Soil Technology.

E. J. WICKSON, M.A., Professor of Horticulture, Emeritus.

W. S. WILKINSON, B.S., Assistant in Agronomy, El Centro.

C. J. WILLIAMS, B.S., Assistant in Agricultural Extension, Sacramento County.

W. W. WOBUS, B.S., Assistant in Agricultural Education.

F. W. WOLL, Ph.D., Professor of Animal Nutrition, Davis.

FRANK WOOD, B.S., Assistant in Agricultural Extension, Napa County.

C. W. WOODWORTH, M.S., Professor of Entomology.

Mrs. M. H. WOODWORTH, Assistant in Agricultural Extension.

[3] H. H. YOST, B.S., Instructor in Agronomy, El Centro.

*H. D. YOUNG, B.S., Assistant in Agricultural Chemistry in the Citrus Experiment Station and Graduate School of Tropical Agriculture, Riverside.

J. R. ZION, B.S., Assistant in Viticulture.

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[3] In military service. *Resigned.

REPORT OF THE DIRECTOR

BERKELEY, CAL., June 30, 1918.

TO THE PRESIDENT OF THE UNIVERSITY OF CALIFORNIA:

The activities of the Department of Agriculture have been greatly modified during the year through the declaration of a state of war with Germany by the United States on April 6, 1917. Much greater emphasis than ever has been placed upon the extension work. The research work has been considerably modified to meet changed conditions, as may be seen by examining the several lists of projects which form a part of this report. A study has also been given by the staff of possible methods of reorganization and consolidation for the purpose of attacking the research problems in a more comprehensive fashion. A special résumé of the war activities of the department has been prepared and published in the University of California Chronicle of July, 1918, and forms a part of a general statement of the war activities of the University. Hence these activities will not be mentioned in this report. A summary of the instructional work of the University will be included in the Annual Report of the President. The Annual Report of the Director is therefore this year confined almost exclusively to the research work of the department.

As illustrative of modifications in the research work of the department an examination of the lists of projects published in this report shows that 136 projects have been finished or discontinued, while there are 114 projects on which, although not formally discontinued, no data have been reported during the present fiscal year. Investigations have been reported upon 107 projects which were begun in preceding years, while 55 new projects have been organized during the year. The lines of investigation will be indicated in some measure by the following table, although numbers of projects are not truly indicative of investigational activities, since certain single projects may be as comprehensive and important as a dozen other problems.

An historical review of the research work of the department which serves as a fitting contribution to the Semi-Centennial of the University has been prepared by Professor Edward J. Wickson, Emeritus Professor of Horticulture, who has been connected with the College of Agriculture and Experiment Station for thirty-eight years, and who was its Dean and Director for seven years.

NUMBERS OF PROJECTS CLASSIFIED BY DIVISIONS AND SUBJECT MATTER

Division	New projects	Completed or discontinued	Data reported	No report
Agricultural Chemistry	0	0	0	4
Agricultural Engineering	2	0	1	6
Agronomy	1	0	8	16
Animal Husbandry	9	1	13	9
Botany	0	0	1	0
Citriculture	0	4	5	0
Citrus Experiment Station	2	24	19	8
Dairy Industry	2	0	0	6
Entomology	3	47	3	5
Forestry	0	13	4	5
Genetics	1	2	3	3
Irrigation	6	0	8	3
Nutrition	0	1	0	6
Olericulture	0	0	0	5
Plant Pathology	0	0	3	2
Pomology	19	1	4	5
Poultry Husbandry	4	0	0	4
Rural Institutions	0	0	0	1
Soil Chemistry and Bacteriology	2	11	1	2
Soil Technology	4	7	3	7
University Farm	1	0	4	0
Veterinary Science	0	5	11	3
Viticulture	8	20	16	14
	*64	136	107	114

* Some of these projects are coöperative.

Professor F. W. Woll has prepared a list of publications of the Agricultural Experiment Station for the past fifty years and has prepared a general index to them which will be found useful to all students of agricultural research. This report also includes, as usual, a list of papers by members of the staff, published in scientific and other journals during the current school year.

In connection with Professor Wickson's admirable résumé, attention is called to the discussion of station achievements and of future investigations, in the Director's Annual Report for the year ending June 30, 1916. It is believed that a careful examination of these two reports will enable the citizens of California to form a just estimate of the motives, methods and achievements of its Department of Agriculture.

Respectfully submitted,

THOMAS F. HUNT.

PROJECTS

NEW PROJECTS SINCE JULY 1, 1917

No. 513. Oat Hay vs. Alfalfa Hay for Skim Milk Calves. By F. W. Woll and E. C. Voorhies reporting to G. H. True.

No. 514. The functions of Sulfurous Acid in the Drying of Fruit and in the Storage of Dried Fruit. By W. V. Cruess reporting to F. T. Bioletti and W. L. Howard.

No. 515. The Sugaring of Dried Fruits. By W. V. Cruess reporting to F. T. Bioletti.

No. 516. New Methods of Packing Dried Fruits. By W. V. Cruess reporting to F. T. Bioletti and W. L. Howard.

No. 517. A Study of the Maximum Water Content of Dried Fruits. By W. V. Cruess reporting to F. T. Bioletti and W. L. Howard.

No. 518. A Study of Methods Designed to Prevent Darkening of Fruit During Process without Use of Sulfurous Acid. By W. V. Cruess reporting to F. T. Bioletti and W. L. Howard.

No. 519. Investigations to Determine the Relative Values of Different Preservative Agents for Storage of Eggs. By W. E. Lloyd reporting to J. E. Dougherty.

No. 520. To Determine the Relative Economy of a Limited Compared with a Heavy or Full Grain Ration in Conjunction with Alfalfa Pasture. By J. I. Thompson reporting to G. H. True.

No. 521. The Best Stage of Ripeness at which to Harvest Fruit for Canning, Drying and the Preparation of Jams, Jellies and Other Fruit Products. Discontinued. By F. T. Bioletti.

No. 522. Soil Survey of Grass Valley Area. By C. F. Shaw.

No. 523. A Study of the Dipping of Fruits Preliminary to Drying. By F. T. Bioletti.

No. 524. Grain Stubble for Sheep. Various Rations for Fattening Sheep. By R. F. Miller reporting to G. H. True.

No. 525. Variety Tests of Fruits for Drying. By W. L. Sweet reporting to W. L. Howard.

No. 526. A Survey of the Deciduous Fruit Drying Industry of the State. By the Division of Pomology.

No. 527. Effects of Sulfuring on Fruit Tissues and its Possible Relation to the Palatability of the Dried Product. By W. L. Sweet and W. V. Cruess, reporting to W. L. Howard and F. T. Bioletti.

No. 528. An Experimental Study of the Possible Length of the Storage Period of a Selected Lot of Table Grapes and the Optimum Temperature at which the Fruit should be Held. By R. H. Taylor, reporting to W. L. Howard.

No. 529. Standardization of Fruit Handling Methods for Drying Purposes. By W. L. Sweet reporting to W. L. Howard.

No. 530. An Experimental Study of Equipment for Drying and Curing of Deciduous Fruits on a Commercial Scale. By W. L. Sweet reporting to W. L. Howard.

No. 531. Effects of Stacking in the Process of Drying Fruit. By W. L. Sweet reporting to W. L. Howard.

No. 532. A Study of the Comparative Keeping Qualities of Different Varieties of Pears in Cold Storage. R. H. Taylor reporting to W. L. Howard.

No. 533. The Keeping Qualities of Apples in Cold Storage as Affected by the Health and Vigor of Trees. By R. H. Taylor reporting to W. L. Howard.

No. 534. A Demonstration and Study of the Effect of Degree or Stage of Ripeness of Fruit at Picking upon Its Behavior in Cold Storage. By R. H. Taylor reporting to W. L. Howard.

No. 535. The Adaptability of Range Sheep in the Santa Cruz Mountains. By R. F. Miller, reporting to G. H. True.

No. 536. Design of Transportation Laying House. By J. E. Dougherty in coöperation with H. L. Belton, reporting to J. E. Dougherty.

No. 537. Cost of Producing Lambs on the Farm. By R. F. Miller, reporting to G. H. True.

No. 538. The Use of Barley for Laying Hens. By W. E. Lloyd, reporting to J. E. Dougherty.

No. 539. General Irrigation Investigations in California including Office Routine. By members of the Division of Irrigation Investigations reporting to Frank Adams.

No. 540. Duty of Water in Foothills of Yuba and Nevada Counties, California. By J. B. Brown reporting to Frank Adams.

No. 541. Design and Supervision of Installation of Irrigation Pumping Plant and Pipe Distribution System, including Supervision of Preparation of Land for Irrigation for 200 acres of Farm of Herman E. Berg, near Yuba City, California. By M. B. Williams reporting to Frank Adams.

No. 542. Irrigation Survey of Portion of Byron-Bethany Irrigation Project in San Joaquin, Alameda and Contra Costa Counties. By M. B. Williams and S. H. Beckett and assistants reporting to Frank Adams.

No. 543. War Emergency Project. Division of Irrigation Investigations. Members of Division reporting to Frank Adams.

No. 544. An Investigation to Determine the Relative Effects of Continuous Confinement in the Laying House, Use of Small Yards attached to the Laying House on the Health and Productiveness of Laying Hens. By J. E. Dougherty.

No. 545. Utilization of Cereal Straw for Feeding Dairy Heifers and Dry Cows. By F. W. Woll reporting to G. H. True.

No. 546. New Studies on Nitrogen Fixation. By the Division reporting to C. B. Lipman.

No. 547. Skim milk vs. Whey in Pork Production. By C. M. Vestal and R. P. Royce reporting to G. H. True.

No. 548. To Determine the Relative Values of Milo in Different Forms and Milo vs. Barley for Fattening Hogs. By C. M. Vestal and R. P. Royce reporting to G. H. True.

No. 549. The Use of Bacillus Bulgaricus Starter for Controlling Gassy Milk in the Manufacture of Cheddar Cheese. By H. S. Baird reporting to C. L. Roadhouse.

No. 550. The Manufacture of Cottage Cheese from a Mixture of Skim Milk Using Bacillus Bulgaricus Starter for Curdling the Milk. By H. S. Baird reporting to C. L. Roadhouse.

No. 551. Genetics of Crepis Virens, the Smooth Hawksbeard. By E. B. Babcock and others reporting to E. B. Babcock.

No. 552. Soil Survey of El Centra Area. By C. F. Shaw, W. C. Dean, J. B. Hammon, reporting to C. F. Shaw.

No. 553. Examination of Land Settlement Sites. By B. W. Nelson, W. C. Dean, W. W. Weir and others reporting to C. F. Shaw.

No. 554. Survey of proposed Warm Creek Drainage District. By W. W. Weir, H. F. Bahmeier and C. F. Shaw reporting to C. F. Shaw.

No. 555. Field Trials of Fertilizers and Green Manure Crops with Walnuts. By R. S. Vaile, L. D. Batchelor, and W. E. Goodspeed reporting to H. J. Webber.

No. 556. Use of Water from Kings River. By Harry Barnes reporting to Frank Adams.

No. 557. Control of the Citrophilus Mealy Bug. By H. J. Quayle, A. F. Swain, and C. R. Perrin reporting to H. J. Webber.

No. 558. Intercrops for Deciduous Orchards. By B. A. Madson reporting to W. L. Howard.

No. 559. Studies on the Nutrition of Plants as Affected by Nitrogen and Sulfur and by Salts. W. F. Gericke reporting to C. B. Lipman.

No. 560. Grasshopper Control in the Plumas and Lassen National Forests. By E. R. DeOng reporting to G. P. Gray.

No. 561. A Survey of the Principal Warehouses of the State to Locate and Assist in Controlling Injury to Food Products resulting from Insect Attack. By E. R. DeOng reporting to G. P. Gray.

No. 562. To Test Devices for Identification of Market Hogs. By G. H. True.

No. 564. Dipping Nursery Stock in $CuSO_4$. By R. H. Taylor reporting to W. L. Howard.

No. 565. Curing Prunes. By W. L. Sweet reporting to W. L. Howard.

No. 566. Effects of Cold Storage on Dried Fruits. By W. L. Sweet reporting to W. L. Howard.

No. 567. Labor Required for Harvesting Alfalfa. By T. Tavernetti reporting to J. B. Davidson.

No. 568. Control of Insects in Dried Fruits. By W. L. Sweet and E. R. DeOng reporting to W. L. Howard.

PROJECTS COMPLETED AND DISCONTINUED, 1917–18

No. 7. Toxicity of Insecticides (A) Insecticide Coefficients. Accuracy of Feeding of Testing Arsenicals. By C. W. Woodworth.

No. 26. A Study of the Effects of Irrigation on the Physical, Chemical and Bacteriological Conditions of Imperial Valley Soils. By C. B. Lipman. Completed.

No. 27. A Continuation of Past Studies on the Effects of Salts of the Heavy Metals on Plant Growth. By C. B. Lipman. Completed.

No. 28. A Continuation of Past Studies on the Lime-Magnesia Ratio of Plants, Particularly Oranges. By C. B. Lipman. Discontinued.

No. 30. Fundamental Studies on the Antagonism between Salts as Measured by Bacterial Efficiency in Soils. (Continuation of Past Studies.) By C. B. Lipman. Discontinued.

No. 32. A Study of the Bacterial Flora of Soils in Which Die-back in Citrus Trees Occur, to Determine Whether or not any Relation Exists between the Bacterial Flora of the Soil and the Diseased Condition. By C. B. Lipman. Discontinued.

No. 33. Continuation of Studies on the Bacterial Flora of California Soil Columns to Complete the Comprehensive Physical, Chemical, and Biological Studies Started Some Years Ago at this Station. By C. B. Lipman. Completed.

No. 35. Toxicity of Insecticides: (*a*) Insecticide Coefficients. Comparison of Formalin and Arsenic for Flies. By C. W. Woodworth. Discontinued.

No. 36. Toxicity of Insecticides: (*a*) Insecticide Coefficients. Method of Testing Strength of Flea Powders. By C. W. Woodworth. Discontinued.

No. 37. Toxicity of Insecticides: (*a*) Insecticide Coefficients. Study of Methods of Producing Cyanide Gas of Known Strength and of Testing Air Containing Cyanide. By C. W. Woodworth. Discontinued.

No. 38. Toxicity of Insecticides: (*a*) Insecticide Coefficients. Study of Action of Constant Strengths of Cyanide on Insect Eggs. By C. W. Woodworth. Discontinued.

No. 39. Toxicity of Insecticides: (*b*) Physical Variations. Strength of Tent Material to Determine Specifications for Weavers which will Give Best Compromise between Strength and Tightness. By C. W. Woodworth. Discontinued.

No. 40. Toxicity of Insecticides: (*b*) Physical Variations. Study of Gas Density in Fumigation. By C. W. Woodworth. Discontinued.

No. 41. Toxicity of Insecticides: (*b*) Physical Variations. Nozzle Testing. Construction of Formulae for Nozzle Construction to Obtain any Desired Performance. By C. W. Woodworth. Discontinued.

No. 42. Toxicity of Insecticides: (*b*) Physical Variations. Cause of Fumigation injury. By C. W. Woodworth. Discontinued.

No. 43. Toxicity of Insecticides: (*c*) Specific Variation. Action of Various Arsenicals on Plants and Insects. By C. W. Woodworth. Discontinued.

No. 44. Toxicity of Insecticides: (*c*) Specific Variation. Action of Petroleum Distillates on Plants. By C. W. Woodworth. Discontinued.

No. 45. Toxicity of Insecticides: (*c*) Specific Variation. Cyanide on Different Scale Insects. By C. W. Woodworth. Discontinued.

No. 46. Toxicity of Insecticides: (*c*) Specific Variation. Nicotine on Plant Lice. By C. W. Woodworth. Discontinued.

No. 47. Toxicity of Insecticides: (*d*) Physiological Variation. Respiration Losses as a Method of Recording Physiological Disturbances due to Insecticides. By C. W. Woodworth. Discontinued.

No. 48. Toxicity of Insecticides: (*d*) Physiological Variation. Tissue Tolerance to Poisons, Normal, Increasing to Immunity and decreasing to Chronic Poisoning. By C. W. Woodworth. Discontinued.

No. 49. Toxicity of Insecticides: (*d*) Physiological Variation. Relation of Temperature changes to Longevity. By C. W. Woodworth. Discontinued.

No. 50. Toxicity of Insecticides: (*d*) Physiological Variation. Progress of Poisoning as Determined by Intervitem Staining. By C. W. Woodworth. Discontinued.

No. 66. A Continuation of Studies on the Effect of the Temperatures of Irrigation Water on the Development of Orange Trees. By C. B. Lipman. Completed.

No. 72. Studies Concerning Infectious Abortion. By C. M. Haring. Discontinued.

No. 95. Studies on the Relative Availability of Nitrogenous Fertilizers for Oranges, Lemons, and Sugar Beets. By C. B. Lipman. Discontinued.

No. 103. Relation of Degree of Maturity of Grapes to Quantity and Quality of Raisins. By F. T. Bioletti. Completed.

No. 105. Wine Grapes for the San Joaquin Valley. By F. T. Bioletti. Completed.

No. 106. Varieties and Methods Suitable for Grape Growing in the Imperial Valley. By F. T. Bioletti. Discontinued.

No. 107. Nature and Causes of the Little Leaf Disease of the Vine. By F. T. Bioletti. Discontinued.

No. 110. Improvement of Methods of Preparing Unfermented Grape Juice. By F. T. Bioletti. Discontinued.

No. 112. Improvement of the Methods of Vinegar Making in California. By F. T. Bioletti. Discontinued.

No. 113. Methods of Germinating Olive Seeds. By F. T. Bioletti. Completed.

No. 123. The Loquot. By J. E. Coit. Discontinued.

No. 126. Insect Industries: (*a*) Bees. Control of Mating. By C. W. Woodworth. Discontinued.

No. 127. Insect Industries: (*b*) Silkworms. Overcoming dependence on Mulberry. By C. W. Woodworth. Discontinued.

No. 128. Insect Industries: (*b*) Silkworms, Field Rearing. By C. W. Woodworth. Discontinued.

No. 129. Life Histories: (*a*) Insect Pests on Agricultural Crops. European Fruit Lecanium or Brown Apricot Scale, and its Parasite Comys Fusca. By C. W. Woodworth. Discontinued.

No. 130. Life Histories: (*a*) Insect Pests of Agricultural Crops. Grape Leaf Hopper and Minor Grape Insects. By C. W. Woodworth. Discontinued.

No. 131. Life Histories: (*a*) Insects on Agricultural Crops. Cut Worms. By C. W. Woodworth. Discontinued.

No. 132. Life Histories: (*a*) Insect Pests on Agricultural Crops. Minor Insects. By C. W. Woodworth. Discontinued.

No. 133. Life Histories: (*a*) Insects on Agricultural Crops. Peach Tree Borer. By C. W. Woodworth. Discontinued.

No. 134. Life Histories: (*a*) Insects on Agricultural Crops. Pear Thrip. By C. W. Woodworth. Discontinued.

No. 135. Life Histories: (*a*) Insects on Agricultural Crops. Insects on Vegetables. By C. W. Woodworth. Discontinued.

No. 136. Life Histories: (*a*) Insects on Agricultural Crops. Insects of Imperial Valley. By C. W. Woodworth. Discontinued.

No. 137. Life Histories: (*a*) Insects on Agricultural Crops. Citrus Insects. By C. W. Woodworth. Discontinued.

No. 138. Life Histories: (*a*) Insects on Agricultural Crops. Codling Moth and Canker Worm on Apples. By C. W. Woodworth. Discontinued.

No. 139. Life Histories: (*a*) Insects on Agricultural Crops. Red Spider. By C. W. Woodworth. Discontinued.

No. 142. Life Histories: (*b*) Forest Insects. Forest and Shade Tree Insects and Their Relation to the Diseases Affecting such Trees. (An Effort to Determine Specifically for Each of our Native Forest Trees, the Exact Effect of Each Species of Insects Attacking them upon the Physiology of the Trees and Just What Insects May be Responsible for Death of Trees). By C. W. Woodworth. Discontinued.

No. 143. Life Histories: (*c*) Parasites on Domestic Animals. Transmission of Fowl Spirochaetosis. By C. W. Woodworth. Discontinued.

No. 144. Life Histories: (*c*) Parasites on Domestic Animals. Spinose Ear Tick. By C. W. Woodworth. Discontinued.

No. 145. Life Histories: (*c*) Parasites of Domestic Animals. Liver Fluke Disease. By C. W. Woodworth. Discontinued.

No. 146. Life Histories: (*d*) Parasites of Human Beings. Housefly Control Methods. By C. W. Woodworth. Discontinued.

No. 147. Life Histories: (*d*) Parasites of Human Beings. Rearing Malaria Parasites. By C. W. Woodworth. Discontinued.

No. 148. Life Histories: (*d*) Parasites of Human Beings. Temperature and Malaria. By C. W. Woodworth. Discontinued.

No. 149. Life Histories: (*d*) Parasites of Human Beings. Pathology of Pajarollo. By C. W. Woodworth. Discontinued.

No. 151. Toxicity of Insecticides: (*a*) Microscopical Identification of Compounds of Insect Powders. By C. W. Woodworth. Discontinued.

No. 152. Toxicity of Insecticides: (*a*) Insecticide Coefficients. Determination of the Toxic Principle of Pyrethrum. By C. W. Woodworth. Discontinued.

No. 153. Toxicity of Insecticides: (*a*) Insecticide Coefficients. Variation in Composition of Phenolic Insecticides. By C. W. Woodworth. Discontinued.

No. 154. Toxicity of Insecticides: (*b*) Physical Variations. Method of Generation, Giving Highest Yield of Hydrocyanic Acid Gas. By C. W. Woodworth. Discontinued.

No. 155. Toxicity of Insecticides: (*b*) Physical Variations. Field Study of Spraying Practice, Quantity Should not Correspond with Volume of Trees, determination of Relation to Dimensions. By C. W. Woodworth. Discontinued.

No. 156. Toxicity of Insecticides: (*c*) Specific Variation. Carbon Bisulphide Dosage. By C. W. Woodworth. Discontinued.

No. 165. Soil Survey of the Bay Region, California. By C. F. Shaw. Completed.

No. 188. The Preservative Treatment of Farm Timbers. By W. Mulford. Discontinued.

No. 189. Reduction in Scale and Grade of Lumber in Yard. Study to be Made in Co-operation with the Forest Service, U.S. Department of Agriculture. By W. Mulford.

No. 192. Green Manure Crops for Southern California. With Special Reference to Their Use in Citrus Orchards. By H. J. Webber. Discontinued.

No. 195. A Comparative Efficiency Test of Orchard Heating Devices. By H. J. Webber. Discontinued.

No. 196. The Histology of Citrus. By H. J. Webber. Discontinued.

No. 198. Lemon Decay Fungi, with Special Reference to Their Control by Wash Water Disinfection. By H. J. Webber. Discontinued.

No. 199. Black Pit of Lemons. By H. J. Webber. Discontinued.

No. 200. Toxicity of Insecticides: (*d*) Physiological Variation Relative to Susceptibility during Slow and Rapid Metabolism. By C. W. Woodworth. Discontinued.

No. 201. Toxicity of Insecticides: (*d*) Physiological Variation Relative to Susceptibility During Slow and Rapid Metabolism. By C. W. Woodworth. Discontinued.

No. 202. Investigation to Determine Cause or Causes of the Spotted Growth in Barley Fields. Some Extremely Good, Some Very Poor. By C. B. Lipman. Discontinued.

No. 205. Seasonal Variation in Nitrifying Powers of California Soils. By C. B. Lipman. Discontinued.

No. 250. Investigations as to the Causes, Manner of Development, and Treatment of Gum Diseases of Citrus and other Fruit Trees. By H. J. Webber. Discontinued.

No. 251. Investigations as to the Causes and Treatment of Melaxuma of English Walnut Trees. By H. J. Webber. Discontinued.

No. 253. Some Studies on Mottling of Citrus Trees. By H. J. Webber. Discontinued.

No. 254. Heart Rot of Citrus as a Result of Freeze. By H. J. Webber. Discontinued.

No. 257. A Study of the Horticultural Conditions in Florida, Cuba, and the Isle of Pines, with Special Reference to Citrus Culture. By H. J. Webber. Completed.

No. 259. A Study of Enzymes in Connection with Plant Diseases. By H. J. Webber. Discontinued.

No. 260. A Study of the Relative Influence of Different Factors on the Composition of Certain Fruits and Nuts. By H. J. Webber. Discontinued.

No. 264. The Comparative Value of Various Paints, Waxes, and Antiseptic Washes as Treatments for Wounds on Citrus Trees. By H. J. Webber. Discontinued.

No. 266. A Study of the Freeze of January, 1913. By H. J. Webber. Completed.

No. 296. Effect of Low Temperature of Sterilization on Quality of Canned Fruits. By F. T. Bioletti. Completed.

No. 297. Collection of Data to aid in the Establishment of Standards for Wine, Raisins and Shipping Grapes. By F. T. Bioletti. Completed.

No. 303. A Study of Date Seedlings of Known Parentage Reared from Cross-Pollinated Seed. By J. E. Coit. Discontinued.

No. 304. A Study of the Conditions under Which Citrus Fruits are Produced in Northern California. By J. E. Coit. Discontinued.

No. 313. A Report of Inquiries from Poultry Raisers of California in Regard to Outbreaks of Disease Among Their Flocks. By C. M. Haring. Completed.

No. 315. Investigations of the Possibility of Extensive Feeding of Alfalfa being a Cause of Barrenness. By C. M. Haring. Completed.

No. 318. The Health of Young Calves as Influenced by Various Systems of Feeding. By C. L. Roadhouse. Completed.

No. 319. Cost of the Manufacture of Olive Oil and Pickles in California. By F. T. Bioletti. Discontinued.

No. 321. Unfermented Orange Juice. By F. T. Bioletti. Discontinued.

No. 323. Toxic Effect of Various Ions of California Wine Yeast and Antagonistic Effects of These Various Ions on Each Other. By F. T. Bioletti. Completed.

No. 324. Unfermented Lemon Juice. By F. T. Bioletti. Completed.

No. 333. Effect of Cross-Pollination of Muscat in Vineyard. By F. T. Bioletti. Discontinued.

No. 334. A Study of the Rooting Habit of Grape Vines Under Irrigation in the Different Soil Types in Imperial Valley. By F. T. Bioletti. Completed.

No. 353. Spraying for Insect Pests on Citrus and Olive Trees. By H. J. Quayle. Completed.

No. 354. The Mealy Bugs of Southern California. By H. J. Quayle. Completed.

No. 355. A Comparative Study of Coccus Citricola Campb. and Coccus Hesperidum, Linn. By H. J. Quayle. Discontinued.

No. 356. A Study of the Life History and Economics of the Scale and Aphid Feeding Coccinellids. By H. J. Quayle. Completed.

No. 357. The Dispersion of Scale Insects by Wind. By H. J. Quayle. Completed.

No. 358. Injection of Cyanide Salts in Citrus Trees for the Control of Scale Insects, and of Blackleaf 40% in Walnut Trees for the Control of Walnut Aphids. By H. J. Quayle. Completed.

No. 359. The Use of the Fungus Isaria in Controlling the Black Scale. By H. J. Quayle. Completed.

No. 361. Survey of Situation of the Citrus Products and By-Products Industries in Southern California. By H. J. Webber. Completed.

No. 363. Strawberry Breeding. By E. B. Babcock. Discontinued.

No. 364. Minor Breeding Investigations. By E. B. Babcock. Discontinued.

No. 365. Study of Forest Distribution and Forest Protection in Northern California. By W. Mulford. Discontinued.

No. 366. Study of Logging Methods and Market Conditions in Coast Region and Northern Sierras. By W. Mulford. Discontinued.

No. 372. Reduction of the Amount of Fortification of Sweet Wines. By F. T. Bioletti. Completed.

No. 376. A Study of the Reproduction of Sequoia Gigantea. By W. Mulford. Discontinued.

No. 381. Variation in Oil Content of Immature and Mature Avocados of the Same Variety. Process of Ripening. By M. E. Jaffa. Discontinued.
No. 384. Training and Pruning of Deciduous Orchard Trees. By W. L. Howard. Discontinued.
No. 399. The Control of Lemon Decay Fungi by Wash Water Disinfection. By J. T. Barrett. Discontinued.
No. 410. An investigation to Determine the Effect, if any, of Hog Cholera Immunization on the Breeding Qualities of Swine and the Comparative Number and Vigor of their Progeny. By C. M. Haring. Discontinued.
No. 411. June Drop of Oranges. By J. E. Coit. Discontinued.
No. 414. Raisins as a Feed for Swine. By G. H. True. Discontinued.
No. 426. The Application of Scientific Management to the Lumber Industry. By D. T. Mason. Discontinued.
No. 427. The Protection of Forests from Fire. By D. T. Mason. Discontinued.
No. 428. The Timber Yield of California Forests, and its Relation to Fire Protection. By D. T. Mason. Discontinued.
No. 429. Forest Management in the Redwood Region. By D. T. Mason. Discontinued.
No. 431. The Need of Volume Tables based on Diameter Eye High Measurements. By Donald Bruce. Discontinued.
No. 432. The Use of Timber on the Farm. By M. B. Pratt. Completed.
No. 446. Artificial Reproduction of Redwood (Sequoia sempervirens). By W. Mulford. Discontinued.
No. 453. Testing Equipment on Forest Telephone Lines. By Donald Bruce. Discontinued.
No. 454. A Study of the Adaptation of Citrus Fruits to the Soils of the San Joaquin Valley, California. By C. F. Shaw. Discontinued.
No. 456. Abnormal Tastes and Odors in Olive Oil. By W. V. Cruess. Completed.
No. 457. Relation of Oidium to the Keeping Qualities of Shipping Grapes. By F. T. Bioletti. Completed.
No. 480. Reconnaissance Soil Survey of Southern California Area. By C. F. Shaw. Completed.
No. 481. Soil Survey of Ventura Area. By C. F. Shaw. Completed.
No. 483. Is a Given Soil Type in Different and Far Separated Regions of California of the Same Nature in all Respects. By C. B. Lipman. Completed.
No. 493. A Synopsis of the Aphididae of California. By H. J. Quayle. Completed.
No. 498. Survey of Proposed Drainage District. By C. F. Shaw. Discontinued.
No. 505. Economical Drying of Wine and Table Grapes. By F. T. Bioletti. Discontinued.
No. 512. Reconnaissance Soil Survey of the Upper (Southern) San Joaquin Valley. By C. F. Shaw. Completed.
No. 521. The Best stage of Ripeness at Which to Harvest Fruit for Canning, Drying and the Preparation of Jams, Jellies and other Fruit Products. By F. T. Bioletti, Discontinued.
No. 552. Soil Survey of El Centro Area. By W. C. Dean, J. B. Hammon, reporting to C. F. Shaw. Completed.

PROJECTS BEGUN IN PRECEDING YEARS ON WHICH DATA HAVE BEEN ACCUMULATED DURING THE YEAR

No. 16. A Systematic Study of the Important, So-called Physiological Diseases of Plants Occurring in California. By R. E. Smith.

No. 21. Study of Hybrids of 1st, 2nd and 3rd Generations Between Various Species of Nicotina both Wild and Cultivated. By W. A. Setchell.

No. 23. The Intradermal Tuberculin Test for Detecting Tuberculosis. By C. M. Haring.

No. 24. A Study of the Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California. By C. M. Haring.

No. 51. Reclamation of Alkaline Lands by Flooding and Tile Drainage. By C. F. Shaw.

No. 55. Technical Improvements in the Manufacture of Hog Cholera Serum and Virus. By C. M. Haring.

No. 59. A Record of the Results of Hog Cholera Immunization at the University Farm. By C. M. Haring.

No. 61. Certified Dairy Inspections. By C. M. Haring.

No. 62. Tuberculin Testing of Cows in Certified Dairies. By C. M. Haring.

No. 63. Bacteriological Examinations of Certified Milk. By C. M. Haring.

No. 82. Crop Production and Soil Management in Relation to Soil Type at Imperial Valley Station. By J. W. Gilmore.

No. 84. Miscellaneous Plantings. By J. W. Gilmore.

No. 86. Culture Methods for Alfalfa When Used for (1) Pasture; (2) Hay Production. By J. W. Gilmore.

No. 89. Walnut-Oak Hybrids: Study of a New Form of Juglans Californica: Teratology in Juglans Californica; Allied Problems. By E. B. Babcock.

No. 92. A Study of the Effects of Alfalfa as Exclusive Feed in the Development of the Dairy Calf and Heifer for Dairy Purposes. By G. H. True.

No. 97. Tests of New and Little Known Varieties of Vines. By F. T. Bioletti.

No. 98. Resistant Stocks for Californian Vines. By F. T. Bioletti.

No. 104. Resistant Stocks for Raisin Varieties. By F. T. Bioletti.

No. 114. Preparation of Collection of Olive Trees at Davis, Kearney and Imperial and of specimens at Berkeley. By F. T. Bioletti.

No. 117. Minor Investigations in Plant Pathology. By R. E. Smith.

No. 118. A Study of the Bacterial Disease of Olives Known as Olive Knot, with the Purpose of Discovering the Method of Dissemination of the Causative Organism and the Conditions Governing Infection, the Perfecting of a Practical Method of Control or Eradication and Study of the Pathological Changes Connected with the Knot Formation. By R. E. Smith.

No. 158. The Pollination of Domestica and Triflora Plums under California Conditions. By W. L. Howard.

No. 159. Student Laboratory Plantings—A Study of Fruit Tree Stocks, Pruning and Planting Methods. By W. L. Howard.

No. 160. Death of Animals and Cases of Serious Sickness at University Farm. By H. E. Van Norman.

No. 161. Weekly report of work in progress at University Farm, by Farm Division, Repairs and Power Division and Grounds. By H. E. Van Norman.

No. 174. Rotation Experiments. By J. W. Gilmore.

No. 178. The Effects of Frost on Vines and Methods of Control. By F. T. Bioletti.

No. 180. An Experiment to Determine the Cost of Fitting Beef Cattle for the Show-Ring. By G. H. True.

No. 186. The Practicability of Growing Vegetables on the University Farm. By H. E. Van Norman.

No. 190. Cross-breeding Peaches with Reference to (1) Improved Fruits, (2) Improved Rootstocks, (3) Study of Inheritance in Amygdalus. By E. B. Babcock.

No. 193. The Effect of Different Stocks on Commercial Species and Varieties of Citrus. By H. J. Webber.

No. 197. Study of the Comparative Infectiousness of the Crown Gall Organism (Bacterium tumefaciens) with Special Reference to Finding Resistant Forms of Prunus suitable as a Rootstock for the Various stone fruits. By H. J. Webber.

No. 204. The Modification of Soil Flora through Climatic Influences. By C. B. Lipman.

No. 252. Routine Examination of Material Sent to the Citrus Experiment Station and Minor Studies in Mycology and Bacteriology. By H. J. Webber.

No. 265. Citrus Survey. By H. J. Webber.

No. 268. Studies in Silage Reduction: (*a*) Changes in Chemical Composition of alfalfa, oats, sorghums, kafir and milo during the siloing process. (*b*) Losses of Dry matter and its components in the siloing process in the case of the preceding crops. By G. H. True.

No. 269. The Influence of Barley on the Milk Secretion of Cows. By G. H. True.

No. 282. Sudan Grass Experiment. By J. W. Gilmore.

No. 283. Experiments with Non-Saccharine Sorghums, Saccharine Sorghums and Broom corn. By J. W. Gilmore.

No. 284. Corn Experiments. By J. W. Gilmore.

No. 286. Bean Experiments. By J. W. Gilmore.

No. 305. The Avocado. By J. E. Coit.

No. 312. Investigation of Roup (Avian Diphtheria) and Chicken Pox (Epithelioma Contagiosum). By C. M. Haring.

No. 313. A Report of Inquiries from Poultry Raisers of California in Regard to Outbreaks of Disease among Their Flocks. By C. M. Haring.

No. 314. Co-operative Extension Work in the Prevention of Hog Cholera in Co-operation with the U.S. Department of Agriculture. By C. M. Haring.

No. 319. Cost of the Manufacture of Olive Oil and Pickles in California. By F. T. Bioletti.

No. 335. Observations and Studies on Internal Decline of Lemons. By H. J. Webber.

No. 336. A Study of the Chemical and Physical Effects of Nitrate of Soda on Citrus Soils. By W. P. Kelley.

No. 349. A Study of the Birth Weight and Rate and Cost of Gain from Birth to Weaning of Lambs from Ewes of Different Ages and Breeds. By G. H. True.

No. 352. A Study of the Fumigation Process with Special Reference to the Chemical Problems Involved. By H. J. Quayle.

No. 360. Study of Cost Accounting for Citrus Orchards with a View to Determining as Far as Possible the Actual Value of Cultural Practices. By H. J. Webber.

No. 368. Walnut Breeding Investigations. By H. J. Webber.

No. 369. Walnut Root Stock Investigation. By H. J. Webber.

No. 370. Alfalfa and Succulent Feed for Dairy Heifers and Cows. By G. H. True.

No. 371. Comparison of the Effects of Long and Short Pruning on Varieties Which are Commonly Pruned both Ways. By F. T. Bioletti.

No. 380. Capri Figs and Caprification in California. By J. E. Coit.

No. 387. A Physiological Study of the Effect of Pruning Upon the Growth and Productiveness of Citrus Trees and Other Horticultural Plants Grown under Irrigation in Arid Regions of Southern California. By H. S. Reed.

No. 388. A Study of Ammonification and Nitrification in the Soils of Southern California with Special Reference to the Fertilizer Plots of the Citrus Experiment Station. By W. P. Kelley.

No. 390. Relation of the Number of Vines per Acre to the Quantity and Quality of the Crop. By F. T. Bioletti.

No. 391. Relative Fruitfulness of Canes Originating on Two-Year-Old- Wood (Fruit-canes) and Canes Originating on Older Wood (Water Sprouts and Suckers). By F. T. Bioletti .

No. 392. Effects of Summer Pruning on the Quantity and Quality of the Crop and on the Vigor of the Vine. By F. T. Bioletti.

No. 406. Tests of Chemical Means and Cultural Means for the Control of Wild Morning Glory (Convolvulus Arvensis). By C. W. Woodworth and H. E. Van Norman.

No. 407. Sudan Grass as a Forage Crop for Sheep. By G. H. True.

No. 408. Table Figs in California. By J. E. Coit.

No. 409. The Dried Fig Industry in California. By J. E. Coit.

No. 411. June Drop of Oranges. By J. E. Coit.

No. 415. Walnut Blight: Investigation for Control. By J. T. Barrett.

No. 423. Control of the House Fly and Stable Fly upon the University Farm. By E. R. DeOng.

No. 430. Factors Affecting the Cost of Log Making and Skidding. By W. Mulford.

No. 431. Need of Volume Tables Based on Diameter Eye High (D. E. H. 5 feet 3 inches). By Donald Bruce.

No. 432. The Use of Timber on the Farm. By M. B. Pratt.

No. 437. Reconnaissance of California Practice in the Irrigation of Deciduous Orchards. By F. Adams.

No. 439. Duty of Water in Rice Irrigation in California. By F. Adams.

No. 440. Irrigation of Vineyards. (Continuation of Informal Co-operation running since 1911). By F. Adams.
No. 441. Irrigation of Orchards and Small Fruits (Davis). By F. Adams.
No. 442. Irrigation Investigations with Field Crops (Davis) Demonstration of Measuring Devices. (Succeeding U. C. Project 167 completed with end of Season, 1915). By F. Adams.
No. 445. Fixation of Nitrogen by, and Nitrification of Legumes. By H. J. Webber.
No. 450. The Preparation of Land for Alfalfa Irrigation in Northern and Central California. By F. Adams.
No. 451. Pumping and Irrigation. By F. Adams.
No. 454. A Study of the Adaptation of Citrus Fruits to the Soils of the San Joaquin Valley, California. By C. F. Shaw.
No. 455. Sunburning and Winter-Killing of Walnut Trees. By L. D. Batchelor.
No. 460. Wool Investigations; Growth and Shrinkage of six and twelve months Wool. By G. H. True.
No. 467. Demonstration of Method of Growing Raisin Grapes. By F. T. Bioletti.
No. 468. Potato Improvement by Hill Selection and Tuber-Unit Methods to Determine its Practicability for the Truck Grower. By S. S. Rogers reporting to E. B. Babcock.
No. 470. Pollination Studies. Staff of Division of Pomology.
No. 472. Studies in Dairy Production by High-Producing Cows. By F. W. Woll reporting to G. H. True.
No. 473. Whole vs. Ground Grains as Feeds for Young Dairy Calves. By F. W. Woll reporting to G. H. True.
No. 475. Preparation of Volume Tables for Principal Californian Species. By W. Mulford.
No. 477. Cover Crop Breeding. By L. D. Batchelor reporting to G. H. True.
No. 484. To Determine the Relative Value of Milo in Different Forms for Pork Production. By J. I. Thompson reporting to G. H. True.
No. 485. Skim Milk vs. Whey in Pork Production. By J. I. Thompson reporting to G. H. True.
No. 487. Prune Studies. By Staff of Pomology.
No. 491. Studies in Soil Moisture. By E. E. Thomas reporting to W. P. Kelley.
No. 492. The Fruit Bark Beetle. By H. J. Quayle.
No. 493. A Synopsis of the Aphididae of California. By H. J. Quayle.
No. 494. Manufacture of Concrete Irrigation Pipe. By S. H. Beckett reporting to F. Adams.
No. 499. Grape Syrup as a Substitute for Sugar in Canning. By F. T. Bioletti.
No. 500. A Survey of Utilization of Garbage for Feeding Swine in California. By C. M. Haring.
No. 501. Increasing the Lamb Crop on the Range. By G. H. True.
No. 481. Soil Survey of Ventura Area. By C. F. Shaw.
No. 507. Drying Vegetables. By F. T. Bioletti.
No. 510. Entomological Field Work. By E. R. deOng.
No. 511. Preservative Treatment for Wood Silos. By J. B. Davidson.

PROJECTS BEGUN IN PRECEDING YEARS ON WHICH NO DATA HAVE BEEN FILED

No. 5. The Immunization of Calves to Tuberculosis with "Bovovaccine." By C. M. Haring.

No. 25. A Chemical, Biological and Physiological Study of Alkali in Soils in Its Relations with Crop Production. By C. B. Lipman.

No. 34. Co-operative Experiments in the Control of Bovine Tuberculosis. By C. M. Haring.

No. 53. Concentration of Hog Cholera Serum and the Precipitation of the Immune Bodies. By C. M. Haring.

No. 76. Metabolic Experiments with Young Poultry. Protein Experiments. By M. E. Jaffa.

No. 77. Metabolic Experiments with Young Poultry. Corn Protein Experiments. By M. E. Jaffa.

No. 87. Metabolic Experiments with Young Poultry. Barley Protein Experiments. By M. E. Jaffa.

No. 91. Metabolism of Fresh Milch Cows. By G. H. True.

No. 94. Breeding Experiments with Bulbous Plants. By E. B. Babcock.

No. 96. Improvement of Bearing of Fine Varieties by Selection. By F. T. Bioletti.

No. 102. Transmissibility and Degree of Permanence of Vegetative Variations of the Vine. By F. T. Bioletti.

No. 115. Improvement of Methods of Pickling Olives. By F. T. Bioletti.

No. 116. A Study of Armillaria Mellea, with the Purpose of Finding Practicable Ways to Put an End to Loss from this Fungus Among Trees and Shrubs Attacked. By R. E. Smith.

No. 119. The Control or Avoidance of Walnut Blight. By R. E. Smith.

No. 140. Life Histories: (*b*) Forest Insects. Host Relationship. By C. W. Woodworth.

No. 141. Life Histories: (b) Forest Insects. Breeding Cage Work. By. C. W. Woodworth.

No. 150. Life Histories: (*d*) Parasites of Human Beings. Mosquito Survey. By C. W. Woodworth.

No. 173. Fertilizer Experiment. By J. W. Gilmore.

No. 176. Variety Trial with Wheat, Barley and Oats in Plots. By J. W. Gilmore.

No. 184. Maintenance of Forage Supply in the Mountain Regions of California. By J. W. Gilmore.

No. 185. Grass and Forage Plant Gardens. By J. W. Gilmore.

No. 187. Almond Culture. By B. B. Pratt.

No. 194. A Study of the Varieties of Citrus Fruits and Their Relatives. By H. J. Webber.

No. 255. Root Diseases of Citrus Trees. By H. J. Webber.

No. 256. Fruit Spots and Stains. Green Spot, and Stains. By H. J. Webber.

No. 258. The Nematode Problem on Citrus Trees. By H. J. Webber.

No. 261. The Breeding and Improvement of Citrus Fruits. By H. J. Webber.

No. 262. The Principles of Heredity in Certain Plants. By H. J. Webber.

No. 263. The Origin, Nature, and Inheritance of Apparent Mutations in Certain Plants. By H. J. Webber.

No. 267. A Study of the Methods for the Determination of Sulfur Dioxide in Dried Fruit. By M. E. Jaffa.

No. 271. Triangular Soil Exchange Experiment. By J. W. Gilmore.

No. 272. Variety Trials with Field Peas and Eight Vetches. By J. W. Gilmore.

No. 275. A Study of the Milk and Cream Supply Furnished to the University Farm Creamery, University Farm, Davis, with the Object of Working out a System of Grading and Paying for Quality. By L. M. Davis.

No. 281. Cultural Experiments With Cotton. By J. W. Gilmore.

No. 285. Potato Experiments. By J. W. Gilmore.

No. 287. Culture Experiments with Cowpeas and Soy Beans. By J. W. Gilmore.

No. 288. Influence of Methods of Surface Treatment of Soil on Yields. By J. W. Gilmore.

No. 293. Studies in Jelly Making. By F. T. Bioletti.

No. 299. General Survey to Determine Cause and Extent of Water Logging in Imperial Valley. By J. W. Gilmore.

No. 307. Agronomical Plant Collection. By J. W. Gilmore.

No. 308. Native and Introduced Species of Trifolium in the United States. By J. W. Gilmore.

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BEGINNINGS OF AGRICULTURAL EDUCATION AND RESEARCH IN CALIFORNIA*

By E. J. WICKSON

1. DREAMS OF THE PIONEERS

Both "agriculture" and "a university" were named in Article IX of the Constitution of 1849, upon the basis of which California was admitted as a state of the Union on September 9, 1850. Both had honorable connections but they were not specifically connected with each other. It was declared that "the legislature shall encourage by all suitable means the promotion of intellectual, scientific, moral and agricultural improvement"; also it is specified that certain funds shall be preserved "for the use of a University... with such branches as the public convenience may demand for the promotion of literature, the arts and sciences." Thus "agriculture" was recognized as fundamental in the support of mankind and "a university" as essential to the promotion of learning, but they were apparently not conceived to have any particular relationship. It is interesting, however, that agriculture is the only vocational interest which is mentioned in the article on Education in the Constitution of 1849.

Efforts to secure establishment of institutions for education and research began very early in the American occupation of California, the first of them being put forth by the missionaries sent to the new country by various religious denominations. Their ideals were naturally those of the older colleges of the eastern states, which if not the only institutions of "higher education" then existing in the United States, were the only ones which had at the time deeply impressed themselves upon the public mind. These ancient and honorable institutions were of a type recognized as most desirable not only by the clergy but also by the throng of influential men of the secular professions who laid the foundations of California as an American commonwealth.

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* It is the intention of the writer to present in connected outlines the enactments, transactions, subject-phases, methods, attainments, etc., without reference to the persons acting therein, except as references to sources of fuller information in the footnotes shall reveal them.

Distinctively Industrial Institutions Desired.—While these efforts to secure "colleges of general culture" were in progress there arose an insistent demand that institutions be established which would determine and impart industrial wisdom, upon the basis of which the people of California could learn to produce materials for their own physical needs and for the development of manufactures and commerce. Agriculture was recognized as the industry essential to such attainment, and its promotion was insisted upon as a public duty to supplement private enterprise which was at the time very active but was lacking the products of systematic research. Many of the pioneers had come from older states where the same need had been clearly disclosed and provision for it urged during the preceding decade. They discerned the even greater need to provide for agricultural research and instruction in California. The following is one of several similar declarations made at about the same date:

> In many of the old countries of Europe they have agricultural schools which have been attended by the happiest results. The State of Michigan has the high honor of first opening a college for the instruction of her youth in the science and practice of agriculture, with a domain of seven hundred acres and an endowment of twenty thousand dollars for two years granted by the State. Wisconsin has followed her example and has also established an agricultural college which I believe is liberally endowed. California should follow in her wake. There is ten fold greater necessity for an agricultural school here. Although agriculture has been successfully pursued here for the last four or five years, yet farming has hitherto been a matter of experiment and must continue so for many years to come. We have a different climate, a different soil and different modes of culture must be adopted from what we have hitherto been accustomed to. The farmer has everything to learn. The books treating of agriculture written in the older states or in England are to him of little account, and notwithstanding all the knowledge and experience acquired by him elsewhere, he finds himself a novice here.... We want then an agricultural college and can have it if the people set about it in downright earnest. The United States government should make up a donation of land for that purpose, and our great land holders in every part of California could well afford to part with some of their broad acres and patronize in a liberal manner such an institution from which in the course of a few years they would reap incalculable benefits.*

Another pioneer utterance specifying a particular line of agricultural research and experimentation and proclaiming the duty of the state to provide for it, is the following:

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* From the annual address by Henry Eno at the State Fair at Stockton. Rep. Cal. State Agr. Soc., 1857, p. 109.

> Possessed of a climate with every grade of heat and cold of all the zones, it is believed that all the fruits and plants indigenous to all climes could be acclimated with great facility for general culture in California. For the successful collection and experimental trial and proper distribution of these, with reliable information as to their habits and uses, there needs to be an initial point of concentration presided over by a botanist of the highest abilities. Owing to the infancy of our State and the natural selfishness of communities thus circumstanced, it cannot be expected that private enterprise will devote the capital necessary for such an undertaking. Therefore it can only be done by legislative endowment, which, by the judicious expenditure of public funds, receives back the evidences of its enlightened stewardship by the prosperity of the people thus promoted.*

The declarations cited above, that such agricultural research as California conditions required must come by law and expenditure of public funds, were made after efforts to secure them by organization of directly interested persons had failed. The law incorporating the California State Agricultural Society granted by the legislature of 1854 provided:

> The Society shall have power to purchase and hold any quantity of land not exceeding four sections... for the sole purpose of establishing a model experimental farm or farms—and for holding exhibitions, etc.

The society could never accumulate funds for this purpose and the law became inoperative. Efforts for community coöperation to the same end were also unsuccessful. In 1859 a society was organized to establish a garden for introduction and propagation of plants for distribution among its stockholders in Sonoma and Napa counties. Apparently many became holders of the stock which was issued to a total amount of $5,000, and they received a donation of twelve and a half acres of land near Sonoma, but their subsequent transactions do not seem to have made impression upon contemporary records.

2. AGRICULTURAL FOUNDATION OF THE UNIVERSITY OF CALIFORNIA

By reason of their discernment of great need for development of institutions for agricultural research and education, which have been indicated by their own declarations and by the failure to secure these by coöperation among themselves, the California pioneers were keenly interested in the movement to secure such institutions by provision of the general government. They regretted the defeat of the first bill introduced by Senator Morrill in 1857 and rejoiced in the final triumph of the measure on July 2, 1862, which assured the establishment of "industrial colleges" in all the states.

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* Pomological report of Wilson Flint. Rep. Cal. State Agr. Soc., 1859, p. 300.

In March, 1866, the California legislature created "The Agricultural, Mining and Mechanical Arts College" and provided for the purchase of a farm of not less than one hundred and sixty acres of land. This institution developed to the extent of having an organized board of trustees and of designating a site. At this point, however, propositions to affiliate efforts for higher education arose, and the inchoate college created in 1866 combined with the College of California, which had been incorporated in 1855 and opened in 1860, in a merging of properties and purposes on the basis of which the legislature created the University of California by an "organic act" passed March 23, 1868. This repealed the Agricultural College act of 1866, transferred the property acquired to the new institution and endowed it also with the funds which the Constitution of 1849 provided for a "university," and made its organization conform to the requirements of the Morrill law of 1862 which gave it title to the grant of public lands therein provided. Thus, also, the state of California discharged the obligations assumed by the adoption of the Constitution of 1849, to provide for the "promotion of agricultural improvement" and for the creation of "a university" attaining the two ends once held to be unrelated, by the plans and endowments of a single institution.

Temperamental Incompatibility.—But the two educational interests which the first California constitution had joined together did for a long time struggle to go asunder. The June of vocational training was wedded to the December of culture on a classical basis and they could not immediately learn and love each other's ways. Although this problem of pedagogical unification was not peculiarly Californian, for it arose for solution in nearly all states, the California phase of it must be briefly cited for the sake of this record.

The attitude of the pioneers who first called for agricultural education was distinctly insistent upon isolation of it both in direction and operation. They wished to have it separated from "culture colleges," from control by their trustees and also from the state itself, even when they called upon the state to create it. This utterance in 1857 reflects the character of all which followed it:

> The State of California has her swamp lands, a part of which, if donated to this object (the establishment of a People's Agricultural College) would assist in placing it on a secure and firm basis.... Although obtaining aid from the federal and state governments it

> should be a people's college and managed by the people for if it is a state institution there is too much danger that it could be a sort of hospital or house of refuge for dilapidated and decayed politicians: neither should it be located within a hundred miles of the seat of government, so that students attending it would be out of the reach of any corrupting influences*

These requirements were covered in the establishment by the state legislature in 1866 of the "Agricultural, Mining and Mechanic Arts College" (previously mentioned), for popular participation in its control was provided for by specifying that its board of eight trustees should include the Governor of the state, the President of the State Agricultural Society, the President of the Mechanics Institute of San Francisco, and five other members to be elected by the legislature in joint session, of which there were to be three from the mining and two from the agricultural counties. It is interesting to note how strenuous an effort was made to keep mining and agriculture on a parity in representation. As the President of the State Agricultural Society counted one for the latter, mining must have three of the elected directors.

The site for the college was chosen by this board of directors within the territory now included in the city of Berkeley; a tract of over one hundred acres north of the present University site for which $30,000 was paid. This was about as near to the prescribed distance of "a hundred miles from the seat of government" as was then thought practicable.

The present interest in this institution which was born in 1866 and killed in 1868, lies in the fact that its provision for government by the people had such weight that its scheme of popular representation on its board of directors was included in the plan for governing its successor, the University of California, of which a certain number of state officers and presidents of societies are *ex officio* regents. But the legislature of 1868 guarded against the danger of shifting points of view and policies by providing for an additional sixteen regents appointed for sixteen-year terms, through whose action a consistent conservative policy has been assured and many disasters which similar institutions have experienced have been avoided.

Although the framers of the Constitution of 1879 practically incorporated the statute of 1868 in their instrument, and thus made the divorcement of agricultural work from University control practically impossible, separatist movements continued and caused more anxiety than danger, until the legislature of 1905 provided for the purchase of a University Farm and its equipment for practical instruction in a representative agricultural environment, as will be considered in more detail in a later connection. It must also be noted that there cropped out from time to time, in the governing board and faculty of the University, individual expressions of belief that agriculture was not really a branch of higher education and that it might be to the advantage of the University to allow it to depart in peace. But this also was impossible under the constitution of the state, and the discussion of it was never a menace, though it did for a number of years seriously limit provisions for the development of agricultural research and instruction.

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* State Fair Address of Henry Eno, *loc. cit.*

A Landless Professorship of Agriculture.—Organization of agricultural instruction and experiment in the University began with the election of a "professor of agriculture, chemistry, agricultural and applied chemistry and horticulture" in 1869,* who, at the State Fair of 1870, made this declaration:

> The University of California proposes to furnish all the youth of the State with a theoretical education leading toward industrial pursuits and to exhibit the practical applications of science to the culture of our varied products, the development of our mineral wealth and our manufactures.... It proposes to furnish the facilities for all needful experiments; to be the "station" where tests can be made of whatever claims attention; to become the exponent and repository of our progressive knowledge.... Its gardens and orchards, formed for instruction, will become a museum of pomology and horticulture.

But there must have been a very slow start in this direction, for this arraignment was made in the Report of the State Board of Agriculture in 1871:

> At Berkeley we have a most excellent piece of land upon which has been expended this year in laying out and general ornamentation nearly nine thousand dollars, but not one dollar to prepare it for agricultural or horticultural purposes. It is understood that the Regents put the time of occupation for agricultural purposes to a period of eight or ten years hence. The agricultural professor has not yet been permitted to plant a tree or make a single experiment on the grounds of the University, either in agriculture or horticulture.

Discontent on the part of the farming interest of which the foregoing may be taken as a typical expression was productive of results, for in 1873, this declaration was formally made by the president of the University:†

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* Incumbent, Ezra Carr, 1869 to 1874.

† Report of President D. C. Gilman, December 1, 1873.

> The University domain is being developed with a view to illustrate the capability of the State for special cultures, whether of forests, fruits, or field crops, and the most economical methods of production. It will be the station where new plants and processes will be tested and the results made known to the public.... A fine estate has been provided, well adapted to the establishment of an experiment station in agriculture, a botanic garden, an arboretum, etc.

A Law-Made Agriculturist.—The claim that the professor of agriculture was not permitted to "plant a tree or make an experiment" (as cited above) was true, but this condition was due to the provision in the organic act (adopted in 1868) that the Secretary of the Board of Regents should be "a competent person, who is a practical agriculturist by profession competent to superintend the working of the agricultural farm," etc. Although the act does not anywhere prescribe that the secretary of the Board of Regents shall act as such superintendent, the early incumbents of the position felt it imperative upon them to do so (although none of them were practical agriculturists) and held all foremen and workmen subject to their orders. The conception of the organizers of the University apparently was that a professor of agriculture was a functionary of the class room and laboratory and should be kept from contact with the earth. Thus it came about that the professor of agriculture had nothing to do with the first planning of field instruction and experiment, and the account thereof is given in the report of the Secretary of the Board of Regents for 1873–75,* as follows:

> Forty acres were prepared for planting with a view to agricultural experiments in 1874; and there were planted five hundred and eighty-four named varieties of tree fruits, seventy-three of grapevines, and ninety-five of various small fruits. The purpose of such plantation is to furnish means of correcting the nomenclature of the fruits already in cultivation, and for supplying hereafter scions and plants for distribution throughout the State, as well as for the introduction of new varieties.

The land thus planted is now occupied in part by Agriculture Hall and Hilgard Hall, the soil being immeasurably better to sustain foundations than fruit trees. In fact, the trees were mostly grubbed out in 1895, long in advance of need for building space, because of unthrift and because, being planted by a "very competent English gardener" chosen by the secretary, they were grown with trunks four or five feet high and were laughed at by visiting California growers as a "frightful example of how not to do it in this country," this being about the only instructional purpose they served. In 1882 report was made upon fruits from the trees. An attempt was made about 1885, however, to render the orchard useful for promotive and publicity purposes, by making exhibits at state fairs, taking particular pains to have all specimens correctly named. One observer to whom the last named character was pointed out replied: "the name-cards are very creditable; they are probably ashamed of the fruit they have to stand for." In 1889 buds were taken from this "standard orchard" to propagate trees to plant at the "outlying stations" established in 1890 (of which account will be given later), and the old trees were also used to a considerable extent as a source of scions which were distributed to growers in various parts of the state, thus serving one of the purposes declared when the orchard was planted.*

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* Incumbent, R. E. C. Stearns, 1874 to 1881.

In 1874 buildings were erected on the grounds set apart for agricultural experiments, viz.: a barn thirty-six by forty-four feet (on the site now occupied by the President's House); a tool house sixty-four by twelve feet; two propagating houses, one sixty-four by fifteen feet, the other thirty by twenty-four feet; a house for hatching fish eggs; and in addition to these large structures a complement of sheds and outbuildings, hotbeds and cold frames were provided. Propagation of shrubs and trees from seed obtained abroad, including large collections of eucalyptus and acacias from Australia, and trees thus secured were used in extending the earlier plantings on the Campus of the University which were made by contract, for it is recorded that in 1873 there were over five hundred specimens of native and foreign shrubs and trees growing on the grounds of the University. It is local tradition that the oldest trees on the slopes in the region of Founders' Rock and the Greek Theatre were planted in 1874.

The Professor of Agriculture Gets Back to the Land.—On August 11, 1874, the Regents of the University "voted to dispense with the services" of the first incumbent of the professorship of agriculture, and elected a successor,† who in 1875 began the first field experiment undertaken by the College, to determine the comparative effects of deep and shallow plowing.‡ Though this experiment was carried out upon what was designated as the "agricultural grounds," it was under the authority of the Secretary of the Board of Regents for the reason already indicated. This condition soon became intolerable. The new head of the agricultural work of the University felt compelled to make an issue against the overlordship of the secretary of the Board of Regents and his "very competent English gardener," and after continuous contention until May 10, 1879, when the Regents declared that all the land north and west of the northerly branch of Strawberry Creek, one of the propagating houses and one-half of the adjacent nursery ground "be set apart for the culture of economic plants under the direction of the professor of agriculture." In 1880 the secretary and his gardener evacuated their share of the joint ownership of land and propagating houses, and the professor of agriculture "enjoyed undisputed possession of the northwest corner of the grounds.* This arrangement continued until about 1900, when the grounds of the University began to be administered by the president upon a rational basis of division by subjects and not by segregating areas.

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* Cal. Exp. Sta. Bull. 75, 1887.

† Incumbent; E. W. Hilgard, 1874 to 1905. Rep. Board of Regents, 1875, p. 13.

‡ Rep. Cal. Coll. of Agr., 1877, p. 20.

3. BUILDINGS OF THE COLLEGE OF AGRICULTURE

Confusion over the relation of the College of Agriculture to the buildings of the University was as great as that over its relation to the grounds, but it arose from very different conditions. As the University was established largely upon the United States land grant for agricultural colleges it was obviously incumbent upon the Regents, as a demonstration of good faith and to satisfy a popular demand, to build a "college of agriculture" which could be recognized as such. To get a teacher and print a course of instruction was almost an admission that the common claim that "agriculture was intended to be only a graft on a classical college" was true. Therefore, a building must rise as a monument of a different purpose, and as a visible token that agriculture was to be the "real thing" in University organization. Accordingly the construction of the "great buildings" to be first entered upon, though not the first to be completed, was the one now known as "South Hall," though its original official title, for the reason stated, was the "college of Agriculture" and over this title it was publicly pictured and described.† A farther declaration of its specific character was furnished by the architect who placed large cast-iron placques or panels on the north and south elevations of the building, illustrating agricultural operations and products. These have been in part considerately concealed by the ivy-growth which adorns the structure, but on the north elevation are still discernible. In this building was housed at first the whole scientific outfit of the

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* See map in Rep., 1888–89, p. 25.

† Rep. Regents of the University, 1872–73; Rep. of U. S. Com. of Agr., 1874.

University, the library and the offices of the secretary, who was by law a "practical farmer" and therefore, of course, should be domiciled in the College of Agriculture, though the farmers themselves did not recognize any agricultural qualification in him.

It seemed rational, from administrative and academic points of view, that the sciences underlying agriculture, chemistry, geology, mineralogy, etc., should occupy the chief space in an agricultural building, and particularly desirable from an administrative point of view, because the Regents had no other roof to place over them. This arrangement, however, did not appeal to the agricultural mind because the farmers expected to have science taught from an agricultural point of view and not farming from a scientific viewpoint. They believed that their long effort to secure agricultural education entitled them to the occupation of the building so clearly dedicated to them, chiefly with instruction and research into the practical arts of agriculture and applied science upon which the development of the state was conceded by all to rest, and they held loudly that to give an agricultural building chiefly to instruction in science for its own sake, was adequate proof that the intention of the University management was to subordinate agriculture, not to exalt it, as the law and the land endowment required. Sufficient indication of the prevalence of such indictment may be had from the declarations by the State Board of Agriculture, while the building was under construction, but after the apportionment of its space had been made on the architect's plans:

> For an agricultural college building we have the basement story of the building called the "Agricultural College," but really designed in the far future for a chemical and metallurgical department. Thus it will be seen that while we have accepted the grant of Congress and nominally established an Agricultural and Mechanics Arts College we have really nothing to show for them in a practical way.*

This state of mind was not alleviated by the subsequent discovery that when the building was finished and occupied, the Agricultural College had only the north half of the basement instead of the whole of it, until the library was moved to a new building a few years later when agriculture was given the equivalent of one floor and really came into possession of one-fourth of the space in a building bearing its name in the public mind and its cast-iron insignia on its outer walls. Nor did agriculture ever come into wider possession of that building. Still, in the half-light of those small basement rooms far-reaching plans were laid, and a beginning was made in research work which subsequently attained notable results. In this basement in 1875 the laboratory of the experiment station work was established, the Regents making provision of $250 per year for the expenses thereof for the first two years; and at the end of this time, the Legislature provided for the continuation and extension of the work, by special appropriations from year to year.

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* Rep. Agr. Soc. 1871, p. 24.

How the Agricultural College Got Buildings of Its Own.—In 1880 the agricultural department entered upon a policy, which prevailed for about twenty-five years thereafter, of providing for its growing need of accommodations by securing new buildings, when possible, but always securing also the use of old structures of any kind to which persuasive entrance could be gained. The first conquest of this kind was part of a carpenter shop which in 1880 was transformed into a viticultural laboratory, and a small cellar for fermentations was excavated beneath it.

In 1884 the department managed to oust its co-tenant, the carpenter, and captured his whole space. This one-story building was reboarded, given a little overhang to its cornice and it looked quite as well as an ordinary two-room district school house. Its dimensions were 45 × 20 feet. This building and the adjacent rooms in South Hall served the department for several years, and the agricultural insignia on the upper floors of South Hall, which had no husbandry behind them, smiled at the noble industry they represented as research work in the interest of that industry which was then beginning to secure world-recognition, proceeded in the frame shack across the way.

In 1889, the fact that the Hatch appropriation allowed $3000 to be used for building stimulated the Regents to add $7000 from their own funds and to erect a new structure on the foundations and cellars of the old carpenter shop which was moved away and subsequently used for a seed house. The new building was estimated when complete to be worth $16,000. Thus the department came to have really a building of its own and all space previously occupied in South Hall was relinquished. The satisfaction over this fact was fully expressed in the report of 1888–89, and engravings of the exterior and floor plans of the building and description of its equipment in detail were given in that document.

In 1897 this building was burned down to the ground floor, which was cleared off and a new building erected upon it at a cost of about $14,000, the cost of re-building and re-furnishing being borne by the state under its policy of self-insurance. This structure was known as the "agricultural building" until the headquarters of the department were moved in 1912 to the permanent building, Agriculture Hall, and since then the original building, still in the service of the department, has been named Budd Hall.

As this frame building soon became inadequate to the needs of the department the policy of annexing vacant shacks was quickly resumed. East of Budd Hall there stood from the beginning a shed for the shelter of saddle horses which brought students to their classes. When bicycles, trolley cars and autos replaced these animals, the traditions and architecture of the old shed were preserved when it was transformed into a veterinary laboratory in 1903, a purpose which it still serves.*

There is a small building to the west of Budd Hall which was also erected when the University was established in Berkeley to shelter a primeval heating plant for South and North Halls in its basement and a University printing office above, but was afterward abandoned for both these uses. In 1903 this building was appropriated for a Fertilizer Control Laboratory to accommodate work entrusted to the Experiment Station by the law which went into effect in that year. It served this purpose until 1908, when the fertilizer work had accumulated money enough from fees to build a new frame building for itself. Then the little building was used as a seed-house and annex laboratory in agronomy and agricultural technology until this work was moved to Hilgard Hall in 1917, and the structure is now multiplying its manifold labors by serving as a warehouse for the division of nutrition.

In 1906 the enlargement of the University Gymnasium required the displacement of an old wing which was sawn free and moved a little distance away. As it was standing with an open side and its upper floors propped up until time for demolition, the agricultural department acquired possession and by putting on a new face and a lot of partitions within, fitted it to house the division of entomology for several years. When this division was moved to new quarters in Agriculture Hall in 1912, the upper part of this old gymnasium fraction was given to the State Insecticide Laboratory, and the lower to the Pure Food Laboratory of the State Board of Health, and the building has continued in these services to this day.

The Fertilizer Control Building, erected in 1908, was furnished with a wing on the west in 1909 for the temporary use of the Pure Food Laboratory (until 1912) and the Laboratory of Zymology until 1917, the building finally becoming the domicile of the division of agricultural chemistry, with the fertilizer control constituted a branch thereof. In 1914 another wing was added on the north side of the original fertilizer control building for the uses of the division of agricultural chemistry.

In 1894 improved quarters for tender plants, which had been persistently asked for from 1880 forward, were provided for the plant work of the agricultural department in the range of glass houses occupying the slope between the Students' Observatory and the garden of the Department of Botany. This was maintained for show plants for a number of years, but was finally devoted to instructional and research activities.

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* For sight of the shed before its veterinary apotheosis, see Rep. 1888–89, p. 32.

Agriculture Scores in the Hearst Plan.—Permanent buildings for the Department of Agriculture were provided in the Hearst Architectural Plan, the site of the drill ground west of California Hall being assigned to them. Subsequently a more desirable and commodious site was selected and a compact group of three large buildings was planned, of which construction of the first (*Agriculture Hall*) was begun in 1910 and the building equipped and occupied in 1912, at a cost of about $200,000. The second (*Hilgard Hall*) was begun in 1916 and equipped and occupied the following year, at a cost of about $375,000. Thus in course of time the College of Agriculture came to have two buildings called by its own names, buildings of dignity, capacity and durability; equal in dignity to other permanent structures of the University. But so great has been the growth of the College and the multiplication of its research and instructional duties that while on with the new it is not even yet off with the old, and has perhaps one-third of its activities still scantily housed in the sheds and shacks in which it made its early struggles for existence and to render public service, as has been described.

4. DEVELOPMENT OF INSTRUCTIONAL ACTIVITIES

It is obviously beyond the scope and purpose of this concrete sketch to undertake even outlines of the pedagogic philosophy which actuated the efforts of those entrusted with agricultural instruction in this institution, interesting as such analysis of local points of view, purposes and methods would be. The student of such matters will, however, find in the declarations of convictions and undertakings published in the reports and other announcements, a wealth of material for consideration. In its earlier years this college, as it passed from encyclopedic to scientific instruction, exerted a marked influence upon the other institutions of its kind in the country. Later, in the rapid development of the idea of deducing science from the results of successful practice as complementary to the older conception of successful practice prescribed by science, this institution learned much from others which proceeded more rapidly in equipment for instruction and investigation in so-called practical lines. On the other hand, this institution proceeded more rapidly than they in the promotion of the scientific point of view and the application of scientific methods of research and it came to be looked upon as a guide and model in this line of effort and in the standards of agricultural pedagogy which it endeavored to maintain. Some facts of leadership in these matters may be incidentally mentioned later.

Demand that Students be Made to Work.—The California farmers who strove so zealously in the decade 1860 to 1870 were strongly imbued with the idea which prevailed widely throughout the country at the time, that agriculture could only be successfully inculcated by compelling youth to do manual labor, that a taste for work must be developed by working and not by exposition of the reasons for working, and by demonstrations of the best way to work to secure most desirable results. They believed that young men should be made to work by an institution, although they as individuals could not force their sons to farming in that way. The California college was among the first to combat this claim. In its first report* argument was made against manual labor for its own sake or to inculcate a habit of working. It was insisted that labor must be instructive and for purposes of demonstration; that to get students by catering to the notions of those who held that dignity of labor must be upheld by requiring manual labor as such, was unwise though it might lead people to send more students and popularize the institution; that labor when required must be enlightening in its nature and therefore really a form of teaching by practice.

This position was unpopular and engendered a belief among farmers that their college had gone wrong. This doubtless reduced the numbers of students attending, but it was influential in inducing other institutions to take a similar stand against providing for uninstructive labor and thus was of value in promoting a truer conception of the proper function of all similar institutions in this regard, and it was noted with satisfaction in 1894 that "uninstructive labor has been abolished as a part of the general course in all but one or two of the agricultural colleges of the United States."†

Another fundamental contention of the California College of Agriculture was that requirements for admission to the regular course should be as high as for other technical colleges of the University and that a grade of instruction in the regular course "on the level of the technical schools in other professions is best adapted to the advancement of agriculture."‡ The maintenance of the conception and claim by this institution forty years ago had a marked influence upon the aims and policies of other institutions and contributed largely to the realization of courses of instruction in agriculture comparable to those in engineering, which are now the accepted standard. But it required strong conviction and true courage to maintain as early as 1877 that "a knowledge of facts and principles and not the achievement of manual dexterity must be the leading object of a truly useful course of instruction in agriculture."*

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* Rep. 1877, p. 8.

† Rep. 1904–05, p. 1.

‡ Rep. 1877, p. 5.

Instruction in Agricultural Practice.—At the same time, however, the importance of instruction in the art as well as in the science of agriculture was distinctly urged and provided for in this institution. While one man was required to assume all the work of organization and administration in addition to instruction in the fundamental sciences of agricultural chemistry and botany, the first help he called for was the appointment of two instructors in practical agriculture.† He might easily, and perhaps naturally, have insisted upon better equipment for his sciences so that more principles might be rapidly demonstrated, but his insight into the situation compelled him to provide first for the application of principles which were then ready for it. Thus instruction wisely began in both science and practice by specialists in each. And it does not detract from the ideality of this subdivision of the subject of agriculture to state that the teaching staff was also equally subdivided, one man continually teaching all the sciences, and another (not always the same man, but always a full average of one) teaching all the practices. It is interesting to remember, however, how narrow an escape from annihilation this practice instructor once had, for one of the University presidents in the '80s said that he "could not see any use in keeping two instructors for half a dozen students," and it was all the scientific instructor could do to keep his practical associate from walking the plank.

But the statistical condition of agricultural instruction was never really as bad as this incident might indicate, for the distinctively agricultural instructors always had students enrolled in other colleges in their classes, because all the so-called "culture colleges" gave their students elective privileges in filling a stated fraction of their required units. Some classical and other students, therefore, elected agricultural subjects for various reasons: sometimes to satisfy their farming parents that they were really "learning something of practical value"; sometimes because the courses were counted "snaps" and passing marks were easily obtained; sometimes the students honestly enjoyed beets and "spuds" as a relief from "Greek roots." As the "elective system" gained ground in general University policy, after the Leland Stanford University planted itself squarely upon it in 1892, our agricultural instructors gained larger classes and a few years later their class rolls included from ten to fifty times as many names as were regularly enrolled as distinctively "agricultural students." This fact gave the general student body of the University a "look-in" at the activities of the College of Agriculture and was a form of publicity which ministered to the later notable increase in enrollment of regular students in the College.

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* Rep. 1877, p. 6.

† Rep. 1879, p. 6.

How Students of Agriculture Were Obtained.—From the beginning systematic and persistent effort had been made to attract students in two ways: first, by offering a definite and reasonable course in distinctively agricultural subjects which would not lead to a university degree; second, by admitting "special students" of mature age, without entrance requirements, except that they must have had some experience in farming, and with no obligations to remain for definite periods. The two-years or "partial course" was formally announced in 1880 to consist of the last two years of the regular course (in the main distinctively agricultural subjects), students without admission requirements to continue as long as they satisfied their instructors and with no hope of diplomas. In 1892 a sort of a half-diploma was requested for such students, but never authorized, which was immaterial because few pupils ever applied for the course.

A few years later the status of "special students" became quite popular with those who had done so much farming that they had no opportunity to prepare for admission as regular students, and admission as "special students" appealed also to others who had become of age without distinguishing themselves in the high-school work which they had undertaken. As such persons were admitted to both the general academic and technical studies given to agricultural students, many of them really achieved full courses and, currently satisfying entrance requirements also, were allowed to graduate. It was with students of this status, and of greater average age than that of students generally, that the college finally acquired a student body of respectable size and the public interest thus enlisted served as another line of publicity for the desirability of the regular course. The result was that in 1904 the enrollment in agriculture included fifty-one regular and fifty special students. Subsequently the ratio of special students to regular rapidly decreased, as more rational specializing in studies and purposes and fuller qualifications for the pursuit of it were insisted upon.

Another contributing cause to the disappearance of the old-line "special students" was the development of instruction on the University Farm which will be discussed later. As applicants for "special" status usually began with an appeal for admission to so-called "practical courses" which had only one prerequisite and that an alleged experience in farming, when the instructors and outfits for practical instruction became superior at Davis, the special students were freely shunted thither and the academic shade at Berkeley was largely relieved of them. Still it should be remembered that during their period, such students helped materially in the popularity and extension of agricultural activity at the University site.

Distinctively agricultural instruction at the University was conducted for nearly two decades by lecture and class-room methods almost exclusively, and very few "courses" were offered. The agricultural instructors were, however, not as idle as their scant enrollment of "agricultural students" might indicate, for they received pupils enrolled in other colleges of the University and they gave more time to research and experiment than to instruction, as will be indicated in another connection. This fact was not generally known, and even in the University itself was not adequately appreciated, as may be inferred from a remark of one of the presidents of the institution about 1890 that he "could not see how the agricultural instructors kept themselves out of mischief." Quite a different view was, however, taken by one of his successors to the presidency who said, a few years later, "the agricultural building is the busiest place on the campus, though the agricultural students are too few to count."

Growth of Staff and Student Body.—It is interesting from a historical point of view to tabulate the numbers of instructors, the courses they offered, and the "agricultural students" enrolled during the last forty years:

DISTINCTIVELY AGRICULTURAL INSTRUCTORS, STUDENTS AND GRADUATES, 1878 TO 1918*

Year	Instructors	Courses of instruction	Students	Graduates
1878–79	2	4	2	1
1879–80	2	5	9	3
1880–81	3	6	17	2
1881–82	3	6	12	4
1882–83	2	6	3	2
1883–84	2	6	1	0
1884–85	3	5	8	1
1885–86	2	6	4	1

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* Decrease in 1917–18 due to diversion by the war.

Year	Instructors	Courses of instruction	Students	Graduates
1886–87	2	7	4	1
1887–88	2	4	6	0
1888–89	2	4	9	1
1889–90	2	8	9	1
1890–91	2	6	7	0
1891–92	3	7	9	0
1892–93	3	7	18	1
1893–94	4	10	17	3
1894–95	4	14	17	0
1895–96	4	16	15	2
1896–97	4	20	21	2
1897–98	4	30	32	1
1898–99	6	33	21	4
1899–00	6	41	31	2
1900–01	8	43	42	2
1901–02	10	38	64	1
1902–03	10	38	98	7
1903–04	12	42	110	7
1904–05	14	47	116	8
1905–06	17	54	128	13
1906–07	16	98	138	10
1907–08	18	99	146	13
1908–09	24	104	174	22
1909–10	24	89	220	24
1910–11	30	90	310	22
1911–12	30	120	409	32
1912–13	40	168	490	43
1913–14	57	200	576	68
1914–15	66	215	619	73
1915–16	64	203	637	87
1916–17	60	200	608	104
1917–18	60	199	385	49

In the foregoing only those giving and receiving more or less prolonged instruction at Berkeley are included. Besides such enrollment there were several years of short courses in Berkeley which were made as practical and illustrated as fully as possible, until the Short Course work was moved to the University Farm, as already stated.

5. THE UNIVERSITY FARM

It was the belief of the pioneers that they had established the College of Agriculture on a farm. Their claim in 1866, as already stated in a previous connection, was that they had a farm but no college. Nearly forty years later the farmers of the next generation made a new claim, and they worried the state considerably about it, and that claim was that they had a college but no farm. During all this period the desirability of instruction by actual demonstration and participation in agricultural practices was urged by the instructors and was called for by the farmers, but the latter demand was almost always associated with separatist propositions and supported by relatively few. The majority of the people interested in improving and extending agricultural instruction, including the farmers themselves, contended for building-up agricultural research and instruction in the University and not apart from it. This preponderating public interest called for investigation of the agricultural problems which confronted agriculture in this new state: they wished for wisdom about soils, plants and their treatment and protection, and the manufacture of agricultural products, etc. Each legislature from 1877 onward made appropriations for special research work, in conformance with demands of various groups of producers, and the public was largely satisfied that the men and equipment for investigation at the University should be employed in such undertakings as the most direct contribution to the development of the state. Most farmers were more desirous that they themselves be educated and assisted in their production than that their sons be educated in the rudiments of farming: the latter undertaking neither the farmers nor their sons were sure that they desired. The result was that for more than thirty years the legislature gave many thousands of dollars each year for research and publication of the results of it, but practically nothing for teachers and equipment for instruction. The popular position was that so far as that was desirable the University could provide for it from the income of its endowment, which, of course, was for exactly that purpose!

But strenuous effort was made continuously by the management of the college to improve its instruction in agricultural practice. As early as 1880* arrangements were made with several farmers to take students to learn methods, and four of them spent several weeks learning raisin making on a pioneer farm in that branch near Woodland. As there were in that year only seventeen agricultural students in the university, the percentage of them participating must be considered satisfactory. In the same year groups of students with instructors began to visit farms, dairies, wineries, canneries, etc., to supplement theoretical instruction with observation of actual practice. This method was continuously followed afterwards as the best possible approach to practical instruction. Places were also secured for students to labor during summer vacations on farms of the kinds preferred by them. These efforts at the attainment of knowledge of methods and materials in actual use were progenitors of the "practice courses" of six or eight weeks in the field, with the instructor in the branch under investigation, which were begun in 1913 and for which students were given credit toward graduation.

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* Rep. 1880, p. 4.

But continuously during the first thirty years of the development of agricultural instruction there was agitation of the need of a real farm for the College of Agriculture upon which students could live a farmer's life and think a farmer's thoughts away from academic distractions and temptations. This agitation was often underlaid by separatist schemes and not altogether free from selfish desires to move the institution to this place or that. When, however, special instruction in the animal industry was entered upon in 1900, and the need of animals and product-appliances to make the instruction concrete, was clearly discerned, various associations of stockmen and dairymen insisted that the University must have a farm of its own in a location more widely representative of producing conditions than anything in the growing city of Berkeley could possibly be. To meet the demands of the stock growers as speedily as possible a "dairy school" was opened in the basement of the agricultural building at Berkeley in 1901, and a practical course of nine weeks was given to thirty-eight students, with purchased milk and chiefly with appliances borrowed from dealers in dairy machinery. In 1902 eighteen head of cattle of different breeds were purchased, a barn was built, and the "University Dairy" was installed on the hill slopes of the eastern portion of the University Campus, the animals finding some pasturage but being chiefly maintained with hay and mill feeds purchased at city prices and hauled to them.

This bluff at practical dairying did not satisfy the stockmen and instruction under actual farming conditions was still demanded. The legislature of 1903 was vigorously appealed to and passed bills making appropriations of $70,000 for the establishment of dairy schools at two points in the state, but these were vetoed by the governor on the ground that all branches of farming should be provided for. A broader and more rational proposition was enacted into a law by the legislature of 1905, providing $150,000 for the purchase and equipment of a University Farm to be selected by a commission created by the law for the purpose.* This commission instructed the Dean of the College of Agriculture† to make personal examination of more than seventy tracts of land which were offered and report upon the availability of each under the terms of the law which required "not less than 320 acres of first-class tillable land ... typical and representative of the best agricultural conditions in California ... capable of successfully producing the general crops of the State ... one-half at least of which is susceptible of irrigation and for the irrigation of which some system is provided." The commission visited several of the tracts and finally decided unanimously to purchase, at a cost of $103,290, the 779 acres adjoining the townsite of Davis in Yolo County, which since that time have borne the title indicated by the law, "The University Farm."

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* The Commission consisted of George C. Pardee, Governor of California; Alden Anderson, Lieutenant Governor; B. F. Rush, President of the State Agricultural Society; Benjamin Ide Wheeler, President of the University, and Ellwood Cooper, State Commissioner of Horticulture.

† Incumbent, E. J. Wickson, 1905 to 1912.

About one year intervened between the approval (on March 18, 1905) of the law providing for the purchase of the University Farm and the decision of the commission to consummate it, as cited above. During this interval there was wide discussion over the desirability of a University Farm at a distance from the University site and the teaching staff of the college was itself divided on the question.‡ Those who maintained that to be useful the farm must be at least adjacent to the University site were supported by distinguished eastern authorities who were invited to visit California and state their views after examining the problem locally. On the other hand, other members of the staff held that following the exact provisions of the law would provide a workable and desirable addition to the instructional outfit in agriculture, providing the equipment and policy at the farm should be arranged to meet the clear intent of the law, viz., to secure a maximum of practical demonstration and a minimum of academic instruction. In this way the farm courses would distinctly supplement and complement the lecture and laboratory courses for regular students at Berkeley and not duplicate or supplant them, while the same equipment and outfit could also be used for more elementary practical courses for many students who were not educationally fitted, or for other reasons did not desire, to pursue regular instructional work at the University itself.

Short courses were announced for the autumn of 1907, but preparations could not be completed for them. Such courses were first given in October and November, 1908, and the University Farm School opened in January, 1909, offering a three-years' course to which pupils having finished the grammar grades, or offering equivalent, were admitted. Both these branches of instruction with notable additions to buildings, equipment and instructional force and with some changes in policies and methods have been continued with the following annual enrollment of pupils:

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‡ Rep. 1903–04, p. 8; Circulars nos. 15, 21, 29; Reps. Cal. State Agri. Soc., 1906, p. 53; 1907, p. 37.

ATTENDANCE OF PUPILS AT UNIVERSITY FARM COURSES DURING FIRST DECADE

Year	Farm school	Short courses	University courses
1908–09	18	109	5
1909–10	42	63	9
1910–11	85	123	16
1911–12	100	163	20
1912–13	157	187	39
1913–14	210	134	63
1914–15	289	186	71
1915–16	314	181	90
1916–17	314	250	94
1917–18	218	348	26

Aside from its direct contribution to the state equipment for a well-rounded system of agricultural education the indirect influence of the provision of the University Farm upon the development of agriculture in the University is of notable historical importance. It would have been very easy to have promoted academic opposition to a distant farm adjunct, to the alienation of those who secured the passage of the law of 1905, which might have resulted in the establishment of a rival institution. This was avoided by earnest acceptance of the popular demand for better and more reasonable equipment and instruction in agricultural practice under good farming conditions. The University Farm was therefore welcomed to University standing; academic attitude was modified to admit it, and academic ideals were expanded to include its functioning. This splitting of the bark on the old stem opened the way for the great development of University agriculture which has been achieved during its fifth decade. The influence of the University Farm has been potent both in expanding the internal operation of the institution and in advancing it notably in public interest, good will and patronage.

The Kearney Bequest.—The suggestive influence of the provision of the legislature of 1905 for a "University Farm" upon the gift of M. Theodore Kearney of Fresno of his whole estate to serve as an adjunct to the College of Agriculture is interesting. When sites were being examined for state purchase Mr. Kearney offered as a gift whatever part of his estate might be considered suitable for the purpose. The property was visited and considered, but though eminently desirable from many points of view, it was held to be too remote from the University to serve the activities specified by the law of 1905. About the time the question was pending in the fall of

1905, Mr. Kearney embodied in a will (which proved to be his last will and testament at the time of his death in 1906) his determination to bequeathe his whole estate for the purposes of the College of Agriculture,* an action which he had contemplated and discussed with an officer of the University, previous to the date of his will, November 21, 1905. The property comprised more than 5400 acres, upon which large expenditures had been made for plantations and buildings; the value of the estate being at the time estimated to be about one million dollars. The purposes for which the gift was made were indicated in a memorandum accompanying the will, to be the endowment of local instruction and experiment in viticulture, etc. To meet claims upon the estate, it was successfully administered by the Regents of the University for several years for income. During this period, the College of Agriculture rented a small tract from the Regents for use in cereal experiments and a small building was provided for this purpose. This constitued the first and only use which the colloge made of the property until 1912. Subsequently considerably greater employment of its opportunities for both field instruction and research were entered upon.

6. UNIVERSITY EXTENSION IN AGRICULTURE

About 1880 the teaching staff of the College of Agriculture consisted of three persons. Two of them were presidents of state associations of farmers; the third was secretary of two such associations. All were called to these positions because of their manifest desire to connect the work of the institution as closely as possible with the interests of practical farmers and to be helpful thereto. This attitude was constantly maintained and as the college staff was increased later by the acquisition of specialists in various lines of instruction and research, embodiments of joint interest in special associations multiplied. In fact, he was a slow specialist who did not proceed to gather his kind of people into affiliation and, of course, it would have been an ungrateful group of people who did not invite their university representative to preside over them. It is not remembered that such a calamity ever really occurred. Certainly a wide and warm popularization of the institution was engendered by the mutual cordiality and devotion which existed between the college men and their subject constituencies.

One result of this mutuality of interest and purpose was the definite entrance upon a system of university extension in agriculture of which the first form was the holding of Farmers' Institutes which began in March, 1891, at the request of the California State Grange. The cost of the meetings was met by allotment of University funds, until a special state appropriation of $6000 per year was enacted for it in 1903, which in 1909 was increased to $10,000 per year. In 1897 a special course of instruction in extension purposes and methods was begun which is believed to have been the first systematic effort for preparation of extension workers. In 1903 reading-courses in agricultural subjects were first announced. In 1908 the first demonstration train was equipped and operated in coöperation with the Southern Pacific Railroad Company. In 1909–10 the activities in extension work included the following: Farmers' Institutes, 100; days engaged, 132; sessions held, 277; attendance, 27,108. Demonstration trains, ran 68 days, milage, 3436; stops for demonstrations, 223; visitors to trains, 73,663. In 1911–12 the trains covered 4000 miles; stops, 238; visitors, 102,624. In the same year there were enrolled 115 reading-course pupils resident in 38 counties.

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* The will of M. Theodore Kearney, in Biennial Rep. of the Pres. of the Univ., 1904–06, p. 46.

In 1909 the College undertook publications and courses of instruction to promote the introduction and pursuit of agricultural subjects in the lower schools and organized its division of Agricultural Education with special reference thereto. In 1909 also credit toward University entrance was allowed for satisfactory pursuit of agriculture in accredited high schools. The college courses were especially planned for qualification of teachers and the publications chiefly designed to assist teachers to undertake successfully school gardening, though particular effort in publication was also made from 1909 to 1911, to interest pupils in plant growing and to promote emulation among them. Direct contact with the boys and girls was established and special publication to interest them was undertaken and reached wide circulation. This work was undertaken largely as a phase of university extension in agriculture.

These attainments in University extension are indicated because they were striven for during the old regime and before the reorganization and complete provision for the work which began in 1913.

7. UNIVERSITY LEADERSHIP IN AGRICULTURAL EDUCATION ASSURED

By virtue of its attainment of a self-conscious agricultural student body in Berkeley, by its successful administration of agricultural property for practical instruction on the University Farm, and by the evidence of its competence to command contributions toward its endowment for greater work, such as the Kearney bequest provided, and by its achievements in University extension, the College of Agriculture reached in 1910 public recognition of its leadership in agricultural research and instruction and public judgment that all state efforts in these lines should be placed under its auspices. These attainments justified this announcement of claim and policy:

> In the diverse undertakings which this department must enter upon to fully represent and serve the agriculture of the State, the University must maintain centers for local research and instruction in representative places in all parts of the State where research can be best done, and where there is opportunity to achieve beneficent results by instruction locally suitable.
>
> But successful work for agriculture at its outposts for teaching and research must depend upon the strongest possible development of agriculture in the University. Every improvement in practical instruction, and every effort to reach and help those who ask for new truth for their own use at home, makes it more necessary that the scientific basis of all practical advancement shall be adequately provided. This basis must be sustained where the sciences, pure and applied, are regularly pursued in research and instruction. Thence must come those contributions to agriculture which lift practice to greater success. To remove the agricultural sciences from their proper associations in the biological group, would be to consign the work in them in California to a lower grade, which is unfortunately the case now in some other States. Properly to equip and environ these agricultural sciences in another place would be to establish another great university in California,—a State which now has a greater per capita endowment of first class university work than any other State of the Union. Such broad science as agriculture must be in the center of a great university. We need many good practical schools of agriculture; their future will depend upon the proper maintenance of agriculture in the highest State school—the University itself.*

8. DEVELOPMENT OF THE EXPERIMENT STATION

It has been shown that the establishment of an experiment station at the University was authoritatively announced as early as 1873 and that buildings and plantations looking toward experimentation were provided in 1874. In 1875 a research laboratory in agricultural chemistry was equipped and in the same year the first local field experiment, to show results of deep and shallow plowing for grain growing was begun. It was this undertaking which gives California priority in the actual establishment of an experiment station in connection with a U. S. land-grant college, although earlier agricultural experiments under institutional auspices may be cited.* For the first fifteen years nearly all of the laboratory research and field experimentation was conducted by those who were primarily employed for instruction and by a few assistants working under their direction. As instruction was in light demand during this period these teachers were kept awake by the popular demand for wisdom through publications, the means for both research and publication being sparingly provided by the legislature of the State. Annual or biennial reports began in 1875–77 and the reports of the "college" were almost wholly filled with the details of research undertakings. In 1884 began the publication of leaflet bulletins which were mailed to "newspapers, other colleges and a few individuals," twenty-five being issued at a cost of $6.00 or $7.00 each for printing and postage: folding and mailing being done at first by the research staff itself. In that year it was declared that at least $250 must be appropriated to cover a year's bulletin publications! There were, however, a few scattering publications in bulletin form undertaken earlier by the University for the Agricultural College, one of which is notable as the first announcement in this country of the availability of carbon bisulphide for the killing of ground squirrels on the basis of actual experiment on the University Grounds.†

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* University of California Chronicle, Vol. XII, No. 1.

In 1884, upon the initiative of the station, the Legislature of California passed a resolution approving a bill then before Congress to provide for experiment stations at all of the agricultural colleges. Such provision was looked upon as the most promising means of securing more ample funds than the California Legislature could at the time be persuaded to provide. In anticipation of such relief, research effort was pursued and diversified; in fact, nearly everything which the local agricultural interests demanded was attacked with such small arms as the little garrison possessed, and the work of the first decade was surprisingly extended and diverse.‡ Naturally, as stated in 1887, "experiment station work continues to form a very large part of the work of the agricultural department of the University."

The Hatch Act establishing experiment stations in all states was approved by President Cleveland, March 2, 1887, and its terms complied with by joint resolution of the California Legislature on March 12, 1889. As, however, the Hatch law provided that establishment could be made by assent of the governor of a state in anticipation of legislative action, the Hatch funds became available in California in March, 1888.

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* Yearbook of U. S. Dept. Agr., 1899. Special edition for Paris Exposition, 1900, p. 514 *et seq.*

† Bulletin of the University of California, April, 1878.

‡ An outline is given in Rep. 1888–89, pp. 19–53.

Ships that Passed in the Night.—It had been the policy of the management of the Station during the preceding decade to insist that California conditions could not be adequately understood, nor served, by the establishment at Berkeley, nor by any other one station, and that it would be "impossible to represent by the work of any single station the conditions of a state co-extensive with the section of the United States from Cape Cod to the Savannah river." As soon then as Hatch funds became available three "outlying culture stations" were established in 1888; for the "foothill region" near Jackson, Amador County; for the "Southern Coast Range region," near Paso Robles, San Luis Obispo County; and for the "San Joaquin valley," near Tulare. In 1890 a regional station for "Southern California" was established near Pomona, Los Angeles County. Each of these stations was established on about twenty acres of land (revertible to the owners in case of disuse), small residences and outbuildings being constructed by local donations. Each was in charge of a foreman and had an outfit of tools, work-stock, etc., and plantings of orchards and vineyards, all supplied and maintained from the Hatch funds. As these four outlying establishments, part of the operation at the central station and the supervision of all of them was maintained by the $15,000 per year of the Hatch fund, the financial stringency of the agricultural department of the University was in no way relaxed by the Hatch endowment. Nor were the results attained very significant on the whole. The funds were insufficient to permit well planned and sustained experimentation calling for adequate labor and materials, nor were the "foremen" qualified, as a rule, to direct experiments and to observe and interpret results. The lessons of the plantations made were, however, locally interesting and to some extent helpful and demonstrative in local development. A few demonstrations were significant and the records of them, as made in the reports and bulletins during the decade following 1892, were contributory to important knowledge. The closing of the stations at Jackson and Paso Robles in 1903, at Pomona and Tulare about three years later, closed the careers of this brood of outlying stations without mourners. Their chief crime was poverty which restricted their undertakings, reduced their custodians to care-takers, and made it impossible to even aim at results of wide significance. And while they existed they prevented development of the central station from securing additional experts who were needed and from properly equipping such workers as were secured. Their chief contribution to the development of the department was the demonstration which they furnished of interest and activity of the institution in local problems and this afterward assisted in securing opportunities for more capable local undertakings.

Welcome Funds for Extension of Research.—The most notable instance of demand for local research facilities was the provision for the establishment of the Plant Disease Laboratory at Whittier and the Citrus Experiment Station at Riverside by the Legislature of 1905. Of this branch establishment mention will be made later in connection with plant-disease work. And these local study centers were superceded by a much broader provision of lands, buildings and income for the Southern California Graduate School of Semi-Tropical Agriculture and Citrus Experiment Station by the Legislature of 1913, the realization of which is beyond the limits of this narrative. It may, however, be cited as the outgrowth of the sound principle of local work upon local problems which prevailed much earlier in the policy of the institution, as already outlined.

The fraction of the Hatch funds which was used at the central station in Berkeley following 1888 met the cost of additional laboratory assistants and supplies and in that way enabled the station to do more work, but research leaders were not increased in number until the funds from the Morrill Aid Funds became available in 1890, which in addition to general university instructors provided two instructors for the College of Agriculture who gave most of their time to research, as their predecessors did, because of the scant demand at that time for teaching.

From the reduction of the number of outlying stations to the abandonment of all of them, the central station increased its expenditures from the Hatch funds and was assisted to expansion thereby, but the growth could not compass the demand for special lines of investigation and the fact induced groups of growers to appeal to the Legislature for special appropriations. The first of these was made by grape growers as early as 1880, and such appropriations were intermittently made afterwards, but were not a trustworthy reliance. After the Hatch funds had failed to satisfy the demand for new investigations, there was renewed demand made by the producers upon the Legislatures and the new investigators and equipment thus secured were the chief support of investigation and added notably to the teaching force which increasing enrollment of pupils necessitated. In the outlines of subjects of station work which will be undertaken later, some facts of special appropriations will be given.

In this connection it is interesting to note that the first notable figures of state appropriations were reached by the Legislature of 1905 which appropriated $389,874.77 to secure distinctively agricultural equipment for the University. This amount was about seven times the average appropriations of other states for that year and was the first time California had approached such figures. The amount has been greatly exceeded since that date by California Legislatures, but the year of 1905 will stand as the birthday of University Agriculture into undisputed state approval and generosity.

Original Use of Research Funds.—It was then to an experiment station respectably equipped and endowed that the Adams Act of 1906 brought funds for additional special researches and found competent men capable of conducting them. These men had lacked funds for efforts of higher scientific rating, while they were performing under state appropriations far more practical experiments. Opportunities for higher research were many and diverse in California and a policy was adopted in 1907 of designating a much larger number of "projects" than stations in other states decided to undertake. This was possible because relatively little of the Adams fund was required for salaries. The investigators were largely paid from other funds; the new funds were chiefly used for agencies and equipment which helped many capable investigators to attack diverse and very creditable research work. The California station was somewhat original in this conception of breadth in Adams undertakings and its policy was, at least at first, questioned by station directors who had conceptions of greater concentration as indispensable in production of anything really new and valuable in agricultural science. They could not realize that, in California, scientific wing-shooting can drop many plump birds.*

9. DEVELOPMENT OF SUBJECTS IN COLLEGE AND STATION

Beyond what are universally regarded as fundamental in subjects of instruction and lines of research, the particular undertakings in both categories were entered upon by the authorities in charge to meet an outspoken popular demand. Manifestly the characteristics and capabilities of local soils and climates were fundamental and knowledge of them was to be approached through studies of meteorology and agricultural chemistry. It is an interesting fact that the crops to the successful production of which knowledge of local soils and climates was most concretely related and most popularly demanded were not the crops which were yielding most value to the state when the institution began its work. Those staple crops were wheat and wool, crops which the people of the state did not desire to pursue and improve, but to displace with others held to belong to a more elevated and enlightened agriculture which would be more directly profitable and indirectly more attractive of population and capital, and therefore more influential in state development. Inasmuch as California was seen to be different naturally from older portions of the United States and as the products found by the pioneers at the Spanish mission were those which belonged to the Mediterranean region and had been figured and idealized in art and literature from classic to most recent times, and as they constituted the materials of commerce of unique character and profitability, it was natural that the throng of home-makers arriving by the newly opened overland railway in the '70s should seize upon the achievements of the padres and the argonauts as indicating that California's great products should consist of semitropical specialties, not producible elsewhere in the United States, which were not only garlanded like Bacchus and embosomed like Pomona, but capable of pouring upon California producers all the gold which the United States was exporting to pay for importations of such productions. This was an economic vision which had been cherished in California for a score of years and enough had been done toward its realization to inspire confidence in the fullest attainment. The result was that when a research agency was established in 1875 to demonstrate the knowledge necessary to such attainment, there was such a pressure toward diversified knowledge that the experiment station was actually not allowed to classify, correlate and discriminate, but was forced to take up a bargain-counter business, by research into foreign records, by local observation, and by current experimentation, which would supply each of a throng of patrons with the particular goods which he conceived to be desirable to him. The California station therefore laid out little work from its own reasonable conception of what it should do to erect a system of agriculture locally desirable, as many other state stations had plenty of chance to do. In California it was from the beginning merely a question of doing as much as possible of what the public demanded and this has been its main problem to the present day. California people generally "want what they want when they want it," and the agricultural interests of the state have always been impatient over having things "wished onto them."

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* This claim, justifying the California policy in apportioning Adams funds, is supported by the fact that after the reorganization of the station under a new director, Thomas Forsyth Hunt, in 1912, the number of Adams projects in 1918 was eleven in active operation.

In undertaking to outline in rough chronological order the subjects which have figured in the work of the California station it will be found that they are scant of relation to each other or to a systematic scheme of agricultural development. Each subject will be separately presented and carried from its beginning to its abandonment or to its assumption of newer phases which continue beyond the scope of this discussion.

10. CALIFORNIA SOIL STUDIES

The only line of work which was formally predestined for the California station was soil investigation and exposition. The actual founder of the station was selected largely on the basis of that kind of work in which he had already attained distinction.* The first analyses of California soils were published in 1877 in connection with the announcement of the beginning of an "Agricultural Survey," the main purpose of which was "to obtain through systematic field explorations by competent persons a full and accurate knowledge of the natural features of the state bearing upon agriculture and related industries... to collect directly from the agricultural population information and experience regarding various crops and modes of culture—for the improvement of instruction and for public information through publications." In 1877 also the first circular inviting the sending of soil samples was issued and two hundred were received. It was intended to make an exhibit of California soils at the Paris Exposition of 1878, but found impracticable. In 1880 the soil collection included 700 samples collected by an assistant who "traveled three months on a hand-car, which could be easily kept out of the way of trains, daily collecting specimens which were currently sent to the University by express from stations currently located." This was the first horseless vehicle systematically used in station work, and station workers who now float about in their Fords should revere the memory of their heroic predecessor who pumped himself for three months through the heat and dust of the interior valleys and foothills on a handcar, collecting the material for the first great work on the soils of California which became a part of the U. S. Census of 1880 and was popularly republished in 1884.† In 1887 soil analyses for private parties was arranged for, the analysts being paid by the applicants and the results "supervised and expounded by the head of the department just as is work in the public interest.'' This was a scheme to secure more data for interpretation in the public interest while the public would not furnish the funds for extended investigation! In 1890 advanced students were for the first time admitted to desks in the agricultural laboratory ''to undertake work which the station needed and for which they received academic credit toward graduation.'' This was another scheme to get data without expenditure, and much knowledge was obtained. It was a new application of hand-car propulsion to the needs of research!

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* In Memoriam E. W. Hilgard, Univ. of Cal. Chronicle, vol. XVIII, no. 2; April, 1916.

† Vol. VI of Tenth Census of the U. S., also Agricultural Features of California, Pacific Rural Press, 1884.

In 1895 the classic experiment in washing-out alkali and rendering the soil productive was undertaken in Tulare* In the same year the first detailed description of methods and appliances for soil and water analyses adopted by the station was published† and commanded wide attention. In 1892 the California station organized and actuated the soil exhibit of the Association of American Agricultural Colleges and Experiment Stations at the Columbian Exposition in Chicago in 1893. Three hundred soil samples were prepared, representing twenty-four states, the samples being prescribed in the form of undisturbed earth sculptured out as a column three feet deep, four inches wide and three inches thick, enclosed in glass-front boxes, each to be accompanied by an analysis showing chemical and physical condition. It was not fully realized as planned, owing to financial and transportational troubles, some of the deep, light loams of California being delivered at the exposition in the form of road dust glistening with the fragments of the glass covers. There was also difficulty with the soil-map of California upon which the station work for fifteen years was condensed in colors. It found no adequate wall space and had to be displayed in fragments which were beyond all recognition of natural sequence or continuity, even in an earthquake country. In 1894 the restored soil map and a larger collection of California soils were shown at the Midwinter Fair in San Francisco. In 1899 the soil map was again revised and sent to the Paris Exposition of 1900, and still again revised it was exhibited at the St. Louis Exposition of 1904, with twenty-seven soil samples taken to a depth of twelve feet and exhibited foot by foot as in nature in vertical columns of bottles. It is believed that this exhibit of soils to a depth of twelve feet was the first of its kind.

While the station was undertaking these spectacular efforts to convince the public of the importance of soil work and to disseminate soil knowledge, the regular analyses of soils and waters and particularly detailed work on the determination and interpretation of alkaline salts in soils was continued. The published records of analyses and discussions cover not less than a thousand printed pages in the station publications alone and at least half as much was currently contributed to periodicals and transactions of societies. The condensation of the whole matter and its interpretation into terms of wide scientific significance and practical importance was fortunately also achieved.*

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* Rep. 1890–91, p. 80. Rep. 1892–93, p. 145.

† Rep. 1891–92, p. 241. Greatly revised in Circular 6, June, 1903.

Upon this historical basis of pioneer work and thought, the station is maintaining leadership in soil science by its later achievements in original investigations and in philosophical exposition of a science which is certainly revolutionary, for it is described as having "passed forever from the old into a new era, of which it has completed the first five and certainly not more than the first ten years." To maintain a leadership in the new era of soil chemistry commensurate with that it commanded in the old era, is the current soil problem of the California Experiment Station.

Tillage.—It should be noted that the relations of depth, fineness and frequency of tillage to the conservation of moisture in soils were pointed out from the beginning as a corollary of the soil investigations made by the station. Demonstrations of the fact had been previously made in all local successes in farming with scant and uncertain rainfall by California pioneers and the station hastened to give reasonable explanations of the fact. It was therefore well known and understood that adequate tillage was the secret of production under semi-arid conditions in California and practice proceeded on that basis for decades before "dry farming" was claimed as a "discovery" in the interior states.

11. PLANT INTRODUCTION AND DISTRIBUTION

To secure the best plants to utilize the natural resources of the state, and to serve the unique industries which they desired to develop, and to make such plants available to all planters was a pioneer conception of fundamental and essential service by a California institution for agricultural research and education. This statement is justified by the allusions to such work in the declarations of purposes of establishment of an agricultural college which preceded realization of it, as has been cited in the opening paragraphs of this writing.

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* Soils: their formation, properties, composition and relations to climate and plant growth, by E. W. Hilgard. New York, The Macmillan Company, 1906; 8 vo., pp. 593.

Such an undertaking therefore appeared to the founder of the college and station not only reasonable but unavoidable. Something more concrete and definite than the first plantings on the University grounds was essential. Their chief motive was ornamentation of the university site through plantings which would also serve a wider purpose. The demand was for plantings which would directly serve state-wide purposes and incidentally achieve local ornamentation and make the university site more attractive and interesting.

In 1879, when the Professor of Agriculture was installed as director of a portion of the University domain, by a process already described, a garden of economic plants was established on the Oxford street frontage at the head of Center street. It occupied nearly two acres of land and was the most active and interesting feature of the open-air work of the institution for thirty years.* For a decade longer it continued existence on a narrower horticultural scope until in 1918 it was obliterated and its site built over with military structures.†

From 1880 onward for twenty years the Garden of Economic plants was the great show-place of the Agricultural Department and it was maintained with great neatness and cultural excellence, with all the small plots of plants accurately labeled. During this period the department had a great thirst for visitors as means of securing desirable publicity. When a visitor of agricultural aspect entered the garden the workman in charge followed instructions and sent a boy, who was kept for telephonic duty, to notify the Director of the fact, and it was his custom to send out all the rest of the teaching staff to explain the plants to the welcome guest, take him to lunch and afterwards keep him well entertained with plant lore until the western sun cast long shadows over the garden and then escort him to an outgoing train. In this way many good friends of the college were developed and many critics disarmed. And indeed there was much to see in that old garden. In 1890 there were (chiefly in the classes of perennial plants and in addition to hundreds of cereals and other annuals) fifty-five plots of grasses, twenty-five of leguminous forage plants, eight of textile plants, twenty-four of aromatic herbs, fifty-nine of medicinal herbs, and forty-one of miscellaneous plants.

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* In 1890 a "Botanic Garden" was established in the valley north of the sites now occupied by California Hall and the University Library. The development of the Botanic Garden is not pursued in this connection because about that time the subject of botany was segregated from agriculture, a department of botany was created and the Botanic Garden was constituted one of its activities. See Rep. 1891–92, p. 166.

† An idea of the garden in its prime can be had from engravings in the Report for 1892–93, p. 338.

Besides, there was the environment of this plotted area of introduced plants which was planted with foreign trees and shrubs yielding commercial products, such as tea, camphor, cinnamon, bamboos, carobs, cork oaks, etc., which were hardy and lived as permanent exhibits, and always others even more interesting in the ways they died, such as cinchona, coffee and many strictly tropical fruits. Of the latter group destined to death, one of the cinchonas played a five-act tragedy, for it lived under most elaborate protection from 1882 to 1887, giving hope of bloom and seed which might yield hardy offspring, but it was killed root and branch by the unusually hard freezing of 1888. Every year, also, there was a fresh planting of the plots given to annuals, from seed from all parts of the world. Of these cereals were predominant and will be mentioned in another connection.

Distribution of Seeds and Plants.—Results in the garden were exponents of desirability in plant and seed distribution and often supplied material for it. Such distribution began in 1880 and continued annually until 1908, recipients being required to pay a small price, partly to meet the cost of the service, but chiefly "because it prevents application from those who would thoughtlessly apply for whatever cost nothing and bespeaks interest enough to secure fair trial of the material received." In this distribution the highest number of applicants was reached in 1895 when there were 1477 applicants residing in fifty-four counties, and the largest amount of material handled in a decade was in 1886–1896, when 85,488 ounces of seed and 93,448 plants were distributed. In the pressure resulting from new and diverse activities at the University Farm and in Berkeley, distribution of seeds and plants by general annual announcement was discontinued in 1908 and since that date has survived in other forms, as found desirable.

In 1903–04 the station coöperated with the United States Department of Agriculture in establishing the Plant Introduction Garden at Chico and the Date Plantation at Mecca, holding the deeds of those properties for the department and consigning much of its interest in plant introduction to the greater resources of the Bureau of Plant Industry.

12. GRASSES AND FORAGE PLANTS

One of the earliest special efforts of the California station, and one which has been sustained throughout its history, was the introduction of drouth-resistant perennial forage plants. The demand for such service was urgently pressed before the establishment of the institution and was one of its inherited obligations. In his address at the California State Fair of 1864, General John Bidwell, an early and capable promoter of the grazing industries, said this:

> California's indigenous grasses, once so abundant as to pasture thousands of animals where only hundreds are able to subsist now, are fast disappearing. Whether any forage plant can be found that will grow upon our hills and plains and become a profitable substitute for the original grasses, remains for the future to bring forth. There must be a remedy in nature, but who will discover it? He who succeeds in making the discovery will be a benefactor of his race and deserve the lasting gratitude of his country. Till this can be accomplished it becomes us to be careful of the grazing capacity of our land; otherwise we destroy what cannot be replaced.*

Such declarations were an inspiration to the beginners of California station work. From the opening of the Garden of Economic Plants in 1879, the world has been ransacked for seed of perennials of forage value and the records of trials of them, both on the University grounds and on the lands of coöperating growers to whom seed was supplied for the purpose, fill hundreds of pages of the station reports. The results are too voluminous to be even cited in this connection. Before the station experiments began, private experimenters had demonstrated relative superiority of four species over all other introductions of grasses, viz., "perennial rye," "orchard," "redtop," and "meadow soft grass." The station experiments approved this list and added others which were commended for trial, but did not pronounce them superior, nor as satisfying the specific demand for winter growth and summer survival of drouth and an early fall revival. Repeated trials of old introductions and of additional exotics demonstrated nothing perennial which would live through the dry season on the driest lands without irrigation. In 1895 only five species of 150 new introductions were, after two years' trial, found worth larger consideration, and none of these were approved later. Out of years of experimentation there were added to the four first mentioned above, six more, viz., "many-flowered millet grass," "Schroder's brome," "awnless brome," "Japanese wheat grass," "Texas blue grass," and "tall oat grass."

Some of these have established themselves and are yielding value in wild pasturage, but none have solved the old problem of hardiness against frost, growth during relatively low winter temperatures and soil-saturation, and either summer growth or, at least, survival of summer heat and drouth on valley plains and foothill slopes. But after nearly forty years of continuous failure to meet these conditions with plants from foreign deserts and swamps, for there is reason to think that the plants we need may have all-around hardiness for both extremes and may be found in either situation, the station is still pressing on with introduction and efforts at acclimatization and is attaining results which are encouraging the hope that the end so long sought may yet be attained.

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* Rep. Cal. Agr. Soc. 1864, p. 212.

Early Beginning with Sorghums and Other Plants.—Introduction of summer-growing annual forage plants for somewhat moist or irrigated land was also begun very early. Comparative growth of saccharine and non-saccharine sorghums, Angola panic, pearl millet and teosinte was made, measured and weighed in 1879 and the growth analyzed in 1880. In 1887 the relative growths of three cuttings were determined, and in 1890 kafir and milo were reported upon. Jersey kale was introduced and distributed in 1891. Johnson grass was widely distributed in 1884 and vigorously condemned in 1890 as not growing where desired but in every place where undesirable.

In 1880 Australian salt-bushes were introduced and tried on coast salt marsh without much success, but they were subsequently found to make great growth on interior alkali too strong to grow other desirable plants and enthusiastic observers reported in 1895 that "the station's announcement of suitability of salt bushes to alkaline soil is worth more to the state than all the money the stations have cost from the beginning." This induced strenuous effort for the widest possible distribution, for analyses showed very high feeding value. In spite of all this glorification and prophecy, salt-bushes are still a negligible factor in our forage resources and there is still some unreclaimed alkali land in the state!

The experiment station was alert and early to demonstrate and denounce the worthlessness of freak forage plants advertised by sensational seed dealers. *Polygonum saghaliense* was introduced from Europe in 1893 and proclaimed to be only of narrow browsing value, before seed dealers glorified it as "sacoline," claiming that cattle could get shade, grass and hay from the same plant; and twenty-five or thirty years before a Portland man offered the same plant as "Eureka clover." The station grew "tagasaste" and cut it out of its forage plots with an axe before dealers started in on its career as "tree-alfalfa." It also showed that Japan clover (*lespedcza*) and many other plants of value in the southern states are valueless in California because they cannot stand frost for winter growing and will not endure our dry conditions of summer growth.

Legumes.—In connection with the availibility of some of them as winter forage plants, a vast amount of comparative observation was expended upon legumes for green-manuring. About 175 species of foreign peas, beans, lupines, etc., were grown in plots at Berkeley and at the substations from 1895 to 1900 and their behavior accurately recorded, but none were found better than the common field pea and vetch which were already in use for winter cover crops. Fenugreek was introduced and distributed by the station in 1892 on the basis of favorable reports from Algeria and proved to be in some localities an acquisition which has rendered much service. The station publications on green-maturing from 1895 to 1904 were very influential in attracting attention to the soil and plant values of cover cropping and were a good foundation for the broader and more systematic investigations which the institution has more recently pursued.

In case the distant reader should wonder why alfalfa, which is California's greatest forage plant, is not mentioned in this connection, it may be stated that alfalfa was introduced from Chile more than twenty years before the station was established and was already conceded to be the best perennial forage plant for conditions which favored its growth. The station was therefore employed with the effort to secure plants for conditions which alfalfa would not accept, until the question of the relative values of different alfalfa varieties arose. Conclusions in this line were not reached during the period covered by this writing.

Much attention was, however, given to legumes which could be counted as substitutes for alfalfa. The most prominent of these, sainfoin or espercet, was grown as early as 1879 and repeated at intervals later, and in 1889 seed was widely distributed for trial. All observations and reports indicated that the plant is in no way comparable with alfalfa for California and is in fact of very doubtful value, in spite of the fact that it is persistently promoted about once in a decade by traveling Californians who observe its behavior in other countries and conceive the plant to be unknown, because unseen, in their own state.

13. CEREALS

Cereal investigations may be considered the first of the station's activities because the first field experiment was in plowing for cereals, in 1875, as already stated. In 1878 a "large collection of European and Asiatic grains" was purchased for use in the lecture room, and when the Garden of Economic Plants was opened there was a natural curiosity to see if any of them would grow. They responded well and the cereal plots excited great interest because of all the peculiar cereals which any visitor had ever seen in the open air these were the most diverse, some of them almost grotesque. As the museum collection had both heads and bottled grain, it was possible to contrast both and so the foreign specimens and their California reproduction were set up for a fair-exhibit in portable glass cases in 1880 and the California-grown cereals showed marked superiority in size of head and plumpness of grain. Californians could naturally expect that, and were accordingly gratified and credited up the institution for being considerably worth while. On several occasions subsequently the collection was regrown for exhibition: 213 cereals in sheaves and bottles being shown at the State and Mechanics Institute fairs in 1887, and 223 varieties thus shown at the Columbian Exposition in Chicago in 1893, and at the Midwinter Fair in San Francisco in 1894, which "won wide commendation and brought this feature of station work to the attention of many people hitherto unaware of it." Subsequently the cereal collection was occasionally regrown in the garden as late as 1903–04. After that cereal growing was transferred to the University Farm.

In 1880 field experiments were made with cutting cereal hay at different stages of growth; also with broadcast vs. drill sowing, and with harrowing grain during growth. In 1880 also the first analyses of California-grown and foreign-grown wheats were made in the station laboratory for comparative purposes. In 1880 also Defiance wheat grown on the station grounds was distributed to growers in the southern coast district where it quickly became popular as a rust-proof variety.

In 1889 seed testing was undertaken to determine quality of seeds the station was then buying for substation planting, and testing of commercial seeds generally was begun in a limited way until 1908, when comprehensive and systematic work was undertaken in coöperation with the U. S. Department of Agriculture. A curious early disclosure was the fact that wheat which was condemned for containing melilotus seed which made the flour from such wheat ill flavored, was lowered in price also if it had alfalfa seed which had no such effect on the flour. The station checked this unfair practice by enforcing distinction between these two seeds in setting prices on wheat.

New Phase of Cereal Work.—In 1887, and for several years following, the whole collection of 326 cereal varieties were grown primarily for observation on resistance of rust and Hessian fly in which wide diversity was shown. In 1901 collections of "gluten wheats" were undertaken in coöperation with the U. S. Department of Agriculture and continued for several years. This led to the opening of a new chapter in the cereal work of the station on the initiative of California millers and grain dealers, to demonstrate the possibility of growing in California, wheats rich in gluten which would lessen or remove the necessity of importing wheats to mix with California wheats in producing high-grade flour. The funds for beginning both field and laboratory work in this line in 1904 were furnished by private subscriptions from millers and merchants and were more amply provided for by state appropriation of $5000 a year by the Legislature of 1905. A formal coöperative arrangement was then entered into for a limited time with the U. S. Department of Agriculture and local cereal stations were operated at several points in the Sacramento and San Joaquin valleys. Subsequently the work was largely concentrated at the University Farm and coöperation with the Department at Washington was terminated.

A special cereal building was erected in 1908 and enlarged in 1910. Movements of quantities of soil from Kansas and other states was undertaken so that wheat could be grown in foreign soil in California climate and experiments begun which demonstrated later that the character of wheat is determined by climate rather than by soil. Centgener selection was also begun. At Berkeley the equipment of the cereal laboratory was extended to include cleaning and milling machinery and ovens for baking tests. Several publications of results were made previous to the reorganization of the division in 1913.

14. FORESTRY

It was more properly sylviculture which this institution most actively entered upon at its beginning: sylviculture only a branch of forestry in the modern method of discriminating specialization, but fundamental and in the minds of the pioneers nearly the whole thing. We shall, therefore, call it "forestry," as they did, both out of respect to their conceptions and for the sake of the fact that, in the progress of the institution, it has recently developed into forestry, broadly conceived and competently striven for.

The planting of the university domain at Berkeley with notable exotic trees in 1874 to serve as a guide for private introductions and propagations has already been suggested and the attainment during the following decade is of record.* In 1879 a policy of propagation of exotics with seed from earlier plantings, not only for local planting but for wide distribution, was entered upon. Of the local plantings none is now (1918) more conspicuous than the grove of blue gums northward of the Le Conte oak. This grove was close planted in 1884, not for forestry purposes, it must be acknowledged, but as a windbreak for the cinder track which at that date was eastward of it. Some eucalyptus adjacent are about ten years older than this grove, as, for instance, a fine viminalis around which the "bleachers" for the early athletic "fans" were assembled.

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* See page 172 *et seq.*, Rep. 1888–89. Upwards of 700 species of trees and shrubs and about the same number of fruits are enumerated in the open-air collections in Berkeley.

Beyond the large collections of eucalyptus and acacia species which attracted people from all parts of the state to Berkeley in 1879, to see these five-year-old Australians, other trees had been planted and were soon disclosing their dispositions toward California conditions. In 1880 oaks from eastern states had manifested unthriftiness, and English oaks had notably outgrown them. Hickories had grown so slowly as to be denounced as unpromising; the pecan had outstripped its class and grown well. In 1887 the cork oak disappointed all promoters of home-grown cork with its lack of vigor. In 1887 also the lower parts of the grounds, which have since been largely cleared for building, athletic and military purposes, were so full of trees and shrubs that permission was secured to plant small arboretums on the eastern slopes, one of which survives in the bunch of trees north of the "Big C" on the first crest of the eastward hills, and for a decade these trees defied the squirrels, drouth and burning grass, before the conifers in a lower crease of the slope were planted and divided perils with them until eucalyptus planting on the hills was undertaken about 1912.

Eucalyptus.—As a result of experiments beginning in 1874 it was announced in 1890 that "as a general thing it may be said that Australian trees are better adapted to this state, especially to the coast section, than any other class of exotic timber trees thus far tried." On the basis of this generalization, subsequently broadened by observation covering results in the interior valleys, there arose about 1906 a speculative "boom" in eucalyptus planting which quickly passed beyond all reasonable anticipations and which the station endeavored to curb by a special publication* on eucalyptus growing, which cited results on the several plantations then operated by the station and on the lands of private growers, also in various parts of the state. This publication exerted a very wholesome influence toward more rational plantings and expectations.

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* Cal. Station Bulletin 196, 1908; partly reprinted in Bulletin 225, 1911, with special reference to behavior of eucalyptus in alkaline soil.

Camphor.—Next perhaps in picturesqueness to its eucalyptus activity, though less disastrous in promoting speculation, was the station's activity with the camphor tree. It was quite common in early days to maintain the eastern states' attitude toward exotics resulting from the conception that they usually needed protection. Strange as it now appears, the early planters of the camphor tree from Japan had that notion, and when the first specimen was secured by the University in the latter '70s, it was cuddled under glass until it clearly resented it by spindling growth and other manifestations of discomfort. In desperation it was planted about 1880 in the Garden of Economic Plants where it speedily acquired vigor and started up to outstrip the adjacent California laurels. Its behavior led to active interest in disseminating the tree as well adapted to the state. Results from distribution previous to 1890 warranted the publication in that year of the wide adaptation of California to camphor growing.

Discussion of commercial plantings for camphor production were common about that time but were not seriously entered upon, although an actual specimen of camphor made in the station laboratories as early as 1882 was continually on exhibition, and although it had by that time been ascertained that camphor trees were actually thriving from open-air plantings in San Mateo County as early as 1864. This latter fact was, of course, not then known to the projectors of the station's camphor crusade.

Previous to 1890 a large planting of mulberry species was made in Berkeley and free distribution of cuttings was made to all parts of the state for projected silk growing enterprises.

Another group of plants to which the station gave much attention previous to 1890 were the wattle acacias. They were widely distributed from Berkeley-grown seed, but no one ever undertook commercial production of tan bark in competition with importations of wattle bark from Australia.

Forestry Stations.—In 1893 the Legislature turned over to the station two "forestry stations" (at Santa Monica and at Chico) which had been established by the first California Forestry Commission organized under the state law of March 3, 1885. The Legislature, however, neglected to continue to the station the $10,000 per year which it had provided for its forestry commission, but reduced its gift to $2000 per year. On this basis the station continued these stations subsequently, often being able to maintain only care-takers upon them. In 1894 the Executive Committee of the American Forestry Association rejoiced that the "wreckage of forestry-station movement in California has fallen into competent hands," etc., but did not appreciate the fact that these hands were empty. Still, in spite of handicaps, the stations were maintained and yielded, through reports and bulletins of a decade following 1893, much interesting data of growth measurements and supplied materials with which the Division of Forestry of the U. S. Department conducted timber-seasoning experiments and hard-wood tests in 1906. The Santa Monica station has always served as a treasury of eucalyptus observations by forestry experts and tourists. As early as 1908 there were seventy named eucalyptus species about ten years of age and bearing seed which was widely distributed to planters through the station's system of seed distribution which has already been outlined.

In the line of forestry research the station began in 1894 coöperative tests of timbers with the university department of civil engineering and the college prescribed previous to 1910 a "pre-forestry course" which would prepare students to enter in advanced standing the forestry courses of eastern universities; several Californians entered upon professional forestry by that route. In the reorganization of the institution a regular division of forestry was constituted in 1914.

15. VITICULTURE

In all undertakings of the California Experiment Station no other branch of agriculture approaches in amount of work and volume of resulting publication, with the growth of the grape and the manufacture of its products, and probably not less than three-fourths of such research, experiment and publication were pursued from the point of view of wine making. This was the most conspicuous illustration of the fact previously stated that the course of the institution was largely shaped, not upon its own conception of what was fundamental and most widely useful, but in accordance with an insistent demand from producers and promoters in that line. When the station laboratories were opened in 1875 a strong promotive effort to advance the quality and increase the production and export of California wines and brandies was abroad in the state and wine analyses were begun. In 1875 field work also began with studies of the phylloxera which had just attracted attention in the Sonoma Valley, and the first publication on viticulture was a discussion of that insect.*

On April 15, 1880, the Governor approved an act of the California Legislature entitled "An act for the promotion of the Viticultural Industries of the States," which created a board of State Viticultural

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* University of California Bulletin no. 23, January, 1876. Revised and republished, 1880.

Commissioners, prescribed their duties and gave them $4000 per year to do them with; also appropriated $3000 for viticultural studies by the agricultural department of the University to pursue investigations into "the arts and sciences pertaining to viticulture, including fermentation, distillation, rectification, management of cellars, etc." It was intended to be a coöperation between the Commissioners and the College of Agriculture, but it resulted, during the first year following, in fermentation among the coöperators fiercer than in the materials they were authorized to investigate. Subsequently for several years there was an armed neutrality between the two institutions though the adherents of both threw gas-bombs quite freely and ill-feeling prevailed for more than a decade, or until in 1894 the first Viticultural Commission was abolished by the Legislature and its properties and functions turned over to the University with an appropriation about one-fifth as large as was previously given to the Commission.

The conflict between the college and the commission was the result of temperamental incompatibility rather than of any irrepressible conflict of principles and was generally looked upon as unfortunate and unnecessary. Possibly, however, it stimulated effort, for while it lasted, both contestants were very active and productive of printing. The publications of the station from 1880 to 1895 on viticulture were almost equal in volume to the publications on all other subjects combined and justified a claim to world-eminence in viticultural work which was made in these words:

> The result of our laboratory work has been to establish a definite basis for rational wine making in this State by determining both the cultural and wine-making qualities of all the more important grape varieties in the several regions where our stations were or are now located.... It is quite certain that in any rational winery practice in the immediate future these facts will have to be taken into definite consideration if the product is to be as good as it can be made under local conditions.... Our work in this line represents the largest and most complete systematic investigation of the kind on record thus far in any country.*

It is obvious that a work of such breadth and detail can only be cited in this connection. It involved the growing of collections of grapes at all of the substations and securing materials also from scores of private vineyards, followed by many hundreds of small fermentations and subsequent analyses and tastings, including the services of probably not less than a score of chemists and palate-experts during the quarter of a century which the complex effort covered. Toward the latter part of this period, that is, subsequently to 1895, more emphasis was laid upon the cultural phases of the industry, the testing of resistant vines, propagation and grafting, and after 1905, largely to pruning according to the nature of different varieties, and protection of vines from pests and fungoid diseases, concerning all of which very discriminating and valuable work has been done. Naturally these lines of work are broader than that to which the station gave chief attention previous to 1895 and greater service has been rendered to the raisin and table grape phases of the industry. Even if the wine industry for which the state first provided special appropriation for promotive research, should be arrested by the changed public attitude toward its pursuit, the other viticultural work of the California station places it in leadership of all American institutions in sustained and comprehensive study of the grape and its products.

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* Cal. Sta. Rep. 1895–96, p. 14.

16. HORTICULTURE

From the earliest times in California the term "horticulture" has been used to designate the growing of tree and brush fruits of all kinds. It was thus used in describing university instruction and experiment with these fruits, until the reorganization of the horticultural department in 1913 when a Division of Pomology was properly installed.

Mention of the earliest undertaking with tree fruits in the planting of a standard orchard of correctly named varieties in 1874 has already been made, and some uses served by that planting have been indicated. In 1882 descriptions and characterization of "little known pears" was begun and continued for several years, in the hope that the supremacy of the Bartlett, which was even then clearly recognized, might be shared with other varieties, but though several varieties were popularized to a limited extent, the supreme serviceability of the Bartlett remains to this day.

Two trees of the Mission olive were planted in 1873 near the east end of the foot-bridge leading from the old greenhouse site to the west end of the botanic garden. One of these trees formerly stood directly in front of the eastward exit from the bridge but succumbed to competition with a deodar which was planted too near to it and which has now (1918) become quite a stately tree. The other was southward of the first about twenty-five feet and still lives, though feeble from the encroachments of English ivy and scale-bugs. This decrepit specimen is the oldest olive on the campus, though others are larger, and it may be imagined to be lingering along in exultation over the fact that its kind (the Mission olive) has never been equalled in commercial value by any of the scores of varieties which the station during two decades imported to supplant it; over the fact, also, that many thousands of cuttings of its more vigorous growth of forty years ago were distributed to start Mission olive orchards in all parts of the state. The largest planting of olive trees on the campus was in 1890, being chiefly of imported European varieties. The best of them were destroyed when the sites for Agriculture and Hilgard halls were cleared. The survivors are on the slope northward of Agriculture Hall, picturesque, but not otherwise of any account.

The Olive Gets the Right of Way.—In 1880 in answer to insistent demand, the olive became a leading line of investigation to determine best varieties, methods of propagation, culture, and very many foreign varieties were introduced and tested. The most notable early result was the demonstration of the desirability of propagation from small new wood cuttings* which subsequently became a common commercial method of nursery propagation. It is hard now to realize the importance conceded to the method at the time of its introduction, for it enabled propagators to quickly satisfy the thirst for new varieties which then prevailed, for they could make a new tree from every match-like piece of new growth on their introductions. From this successful experiment in 1885 work with the olive proceeded elaborately and continuously through the development of olive growing and product-manufacturing to the present time. To all phases of such development the station has contributed influentially, doing more work with the olive than with any other fruit except the grape. In 1890 it was shown that of twenty-two varieties then fruiting, the Mission was most productive. In 1895 about fifty varieties growing at the university substations were pictured and described. In 1898 six hundred and fifty analyses of fifty-seven varieties of olives and olive products were published. About that time and subsequently detailed accounts of oil making and pickling processes on the basis of practical experiments were published abundantly and many problems arising in commercial handling of the fruit were successfully solved.

Impotence of Variety Tests.—Review of the station's work with the olive suggests a generalization which includes many fruits, and that is, the disappointment resulting from extended effort with variety tests. In 1893 there were growing on the grounds at Berkeley and at four substations in other parts of the state (which have been previously discussed), 1158 varieties of tree fruits, including those which were then looked upon as standard commercial varieties.† Probably not one of the varieties planted to compare with those commercially approved was admitted to the list accepted on the basis of earlier experience. But the public demand was irresistibly for such tests and they were undertaken with great confidence. In 1895 to 1897 when this great array of varieties was coming into bearing, this announcement was made:

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* Cal. Sta. Rep. 1887, p. 112.

† Varieties enumerated. Cal. Sta. Rep. 1892–93, p. 474.

> The olive industry is even more dependent upon the intelligent selection of vareties adapted to particular localities than is that of grape growing and wine making. It is notable that no researches of this scope have ever been undertaken in the old world where the varieties grown are such as have been handed down from father to son in each locality and our results will therefore command attention even where this ancient industry has been practiced from time immemorial.*

And the claim was not restricted to work with the olive. Two years later this proclamation was made:

> Our collections already unique on the Pacific coast are certainly larger than any others in America in such departments as olives, walnuts, prunes, European grapes, apricots, almonds and many other imported classes.†

The claim of superior results by selection from large variety collections seems reasonable and the anticipation warranted, and yet it only demonstrated in the case of the olive that the old-world method of demonstrations from previous private plantings made large institutional variety-testing unproductive; for nothing introduced for comparison with the old Mission olive displaced it, just as nothing from station tests knocked the Bartlett pear from its throne. In the case of the apricot, the announcement was made in 1887 that the Blenheim was the best of varieties grown for thirteen years at Berkeley, for regular bearing,‡ but this was only an endorsement of earlier private experience with it. Fifty varieties of figs of recent importation were planted at four substations§ and grown for more than ten years, but no fig entered the California list of "best sellers" by this route, though many of the most promising varieties were propagated and distributed for wide local planting. It seems, therefore, wise that the station investigators in more recent years have directed effort toward fundamental problems which are less susceptible of solution by practical experience than are the adaptability and serviceability of varieties. If it could have been foreseen thirty years ago that varietal effort should be directed toward securing the best forms and performances of varieties already demonstrated to be suitable, rather than to find substitutes for them, more profound horticultural philosophy would have been disclosed and greater public service rendered.

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* Cal. Sta. Rep. 1894–95, p. 8.
† Cal. Sta. Rep. 1895–97, p. 8.
‡ Cal. Sta. Rep. 1887, p. 131.
§ Cal. Sta. Rep. 1891–92, p. 147.

Analyses of Fruits.—Beginning almost as early as did field cultures of tree fruits and vying with them in volume of endeavor were the laboratory studies of fruits from two points of view, viz., the nutritive value of fruits as human foods and the nutritive requirements of the trees through fertilization. Both these lines were elaborately pursued and the results abundantly published. Analyses of oranges and lemons from southern California began in 1880 and continued for twenty years, mainly from the point of view of food value, while for several years following analyses of fruit from trees with various fertilizer treatments were undertaken.* As a corollary of this extended study the commercial production of citric acid was urged in 1887.† Analyses of various deciduous fruits and nuts were systematically undertaken from 1892 to 1898.

Of various fruits it may be noted that seedling date palms were widely distributed previous to 1890 and in the fall of that year imported date plants were established at Tulare and Pomona substations,‡ some of which were subsequently moved to Mecca and assembled with later importations by the U. S. Department of Agriculture. In 1891 to 1893 comparative analyses of California-grown figs and the soil producing them and of Smyrna figs and fig soils brought for the purpose from Asia Minor, were published and a fuller study was pursued in 1898. In 1893 the Loganberry was pictured, analyzed and plants widely distributed.

Why Berkeley Orchards were Abandoned.—About 1895 the orchards at Berkeley began to be reduced. The trees were upon unsuitable soil in a climate no one would choose for commercial fruit growing and any cultural results with them were discounted because the conditions were not representative. Besides, the old college village of Berkeley had developed into a city full of boys with keen appetites for green fruit. For several years a better place for fruit research was longed for and finally provided in the establishment of the University Farm at Davis upon which fruit plantings began in 1908 and were subsequently largely extended. The results belong to a period later than this sketch covers.

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* All reports and various bulletins during the period indicated contain data on composition of California citrus fruits.

† Cal. Sta. Bull. 39, 1885. First publication on studies of California oranges; expanded in Cal. Sta. Rep. 1887, p. 72; Citric Acid Rep. 1887, p. 77.

‡ Cal. Sta. Rep. 1890, p. 222.

Plant Breeding.—Plant breeding in a desultory fashion was pursued in several connections from the establishment of the station until its reorganization in 1913, when a division of genetics was installed. Seedling grape-vines were grown for determination of phylloxera resistance.* Seedling olives were grown to secure, if possible, varieties of especial adaptation to California conditions and other efforts toward selection were made without significant results. Later more systematic enterprises were undertaken in centgener selection of cereals of which the early results were carried over to the reorganization of the Division of Agronomy, and comparative tests of chance variation of lima beans were reported on.† In 1907 studies of walnut grafts on oak trees and alleged walnut-oak hybrids were begun which subsequently resulted in publications upon a new variety of the California black walnut and demonstration of its origin by mutation.‡

17. ENTOMOLOGY

This science is intruded at this point because of its recognized indispensability to viticulture and horticulture and because its development in the University was the result of insistent demand for knowledge of insects by these branches of agriculture. In the beginning the director of the station taught botany for the whole University and lectured on entomology at farmers' gatherings. When he secured his first teaching assistant in 1878 the latter took up instruction in entomology as an amateur because the growing fruit interests demanded it and such instruction was continued by the instructors of agricultural practice until a trained entomologist was added to the staff in 1891. Meantime, in 1882, a separate instructor in botany was provided and botany continued in the College of Agriculture until a separate University department was provided for it in 1892. Why did botany go out of the College of Agriculture into the general organization of university instruction and why did not entomology take the same course? The answer is that temperament and point of view led two men to diverse courses of action. The active botanist of the time was a systematist who did not enjoy economic considerations. The entomologist who lifted entomological instruction from its amateurish beginnings to professional standing held that classification was a means to an end and that the end he desired to pursue was economic and humanistic, and this end was attainable through identification with the college of agriculture. For this reason he remained in the college instead of trying for separate university standing which the botanist attained, or taking the risk of a jump for such standing with a chance of landing finally on a high shelf in the University Department of Zoology.

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* In 1882, 2250 seedlings of *Vitis californis* were distributed to seventy-five growers of infested vineyards, but no satisfactory resistance was obtained.

† Cal. Sta. Bull. 238.

‡ Studies in Juglans, by E. B. Babcock. Nos. 1, 2, and 3, Univ. Calif. Publ. Agr. Sci., 1913 to 1916.

The result was the retention of entomology in the College of Agriculture, the development of instruction from an economic point of view which is essential to the purposes of the college, and the continued service to agriculture for more than a quarter of a century of a man who is too broad in his view and feelings to be a systematist and yet was qualified to achieve systematic organization of his own division, so that it constantly met the demand for instruction and leadership in warfare against injurious insects, and at the same time to contribute more than any other man to keep the whole department in step with the University's progress in pedagogical tactics.

But though the institution was obliged to proceed for more than a decade without a trained entomologist there was much amateur accomplishment. The beginning of the drive on the phylloxera in 1875 has been cited in connection with viticulture. In 1882 special instruction in entomology was begun at the rate of one exercise per week. In 1884 the first publication of remedies for insects was made and in 1887 analyses of insecticides were undertaken and public warnings of adulterations given. In 1887 more than one hundred wheats were reported upon in their relation to resistance of the Hessian fly;* small surface applications of gas lime were shown to be safe munitions against the woolly aphis; local observations on aphis enemies were published, and orchard demonstrations of degree of efficiency of band treatment against the codling moth undertaken and pursued to a publication later.† This was counted by the United States Entomologist in his report for 1887 as "the only attempt with which we are familiar to tabulate the exact proportions between the worms on a tree and those caught by the bands." In 1887, also, an elaborate experiment was pursued in spraying with Paris green and other arsenicals for the codling moth, 71 per cent of apples and pears being saved from intrusion, without injury to foliage or poisoning of fruit, as analysis demonstrated. On the basis of this local demonstration California growers took up this new eastern method of protection, which they had previously feared, thinking the lack of rains would allow the poison to remain in place.

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* Cal. Sta. Rep. 1890, p. 312, and Bull. 58.

† Cal. Sta. Bull. 75, 1887, and Rep. 1890, p. 308.

In 1887 the station, at the urgent request of San Gabriel orange growers, undertook investigation of the feasibility of destroying scale insects on citrus trees by fumigation, a process for which private parties proposed to exact royalties, and after trying many gases, a station chemist made public proclamation of the availability of hydrocyanic gas. This happened to be the discovery upon which the profiteers proposed to proceed and their proposition was gas-bombed thereby. Subsequently fumigation investigations were pursued by the station entomologist for twenty years and notable contributions made to understanding of the agency and introduction of improved methods of application.

By statute of March 15, 1887, the California Legislature required the teaching of economic entomology in the public schools, and was the first state to require entomology except as included in general courses on zoology. This requirement was repealed about five years later, but it had notably quickened public interest in crop protection and was the foundation of expanded voluntary effort which has endured to this time. In 1892 the station entomologist published "a key to detection of the cause of failure of seeds to grow or of plants to be thrifty through injurious insects or fungi," also a "synopsis of families of insects to enable the unscientific public to determine characters of insects suspected of injury to plants." These publications were widely used in elementary instruction and by practical plant growers, and ministered to the expansion of popular interest in plant protection. In 1892 there was also published detailed account of a two-year experiment in spraying a collection of 200 varieties of apples and pears for scale insects, aphis and scab, which was early work of such breadth in that line,* and was followed for several years with full discussion of various remedies for scale insects and fungi.

In 1901, the station urged insecticide control with such force that the Legislature passed the first "Paris green law" which was amended in 1903. In that year one quarter of about twenty tons of Paris green offered for sale in the state was condemned, and of ninety samples submitted by purchasing growers fifty-three were condemned. In the following year very few samples were found unfit, so quickly did the law and the station compel the eastern manufacturers to revolutionize their practices. In 1906 only one seventh of the materials offered for sale were found defective. In 1911 a broader insecticide control law was passed by the Legislature, and the work expanded with great elaboration and beneficent results, beyond the reach of this sketch.

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* Cal. Sta. Rep. 1892–93, p. 441.

In 1903 coöperative investigation and executive control of insects with counties and social organizations was begun and found very productive, notably in the case of apple growing in the Watsonville and San Jose districts. In 1903 also mosquito control was coöperatively entered upon and pushed widely by practical demonstrations and publications. Wide coöperation was also pursued in grasshopper control and in suppression of the Argentine ant, the house fly and other menaces to public health.

It is impossible to characterize all the researches and publications in economic entomology which have established the basis for satisfactory knowledge of scores of pests and for effective procedure against them. Of these the treatments of the potato worm, the peach worm, the groups of vine insects, a notable series of monographs upon the several injurious insects of citrus trees, etc., constitute the greatest volume of close special study and dependable exposition which California has produced. Coincident with this achievement the division was progressively munitioned both for instruction and research by continued attention to collection and classification, and systematic experts provided therefor.

18. PLANT DISEASES

Close to the foregoing in cultural relations, in public demand, and in establishment upon the basis of amateur effort, was the work of the college and station with plant diseases. In 1891 there was only money available to secure one additional instructor and two subjects to be provided for, because the older instructor in agricultural practice, whose field already extended from spud-growing to orchard pruning, wished to sweep both the bugs and the fungi from his rickety chair. And so all commended candidates for election to entomology were asked if they also had training in plant diseases. As several alleged entomologists seemed to be about on a level on insect training and only one claimed plant diseases the latter was selected, although all the qualification he claimed was having listened to a lecture course on fungi and bacteria in Harvard University. And really that seemed to be quite a lot of training in that day, especially as no other candidate for choice as a trained man had had any, and the amateur charged to select his assistant had not been within two thousand miles of places where such instruction was given!

Before the double-barrel specialist on insects and plant diseases who was selected, was aimed at the pressing local problems there had been general exhortation and some observation undertaken on rust-resistance of cereals and blight and mildew-fighting on trees and vines, of which at least one notable event was attained, the first publication in this country* by this station, of Millardet's "copper-lime" fungicidal discovery, which as the "Bordeaux mixture," has since become a universal recourse, although the first tests in California were cited against its efficacy, owing, as can now be seen, to application after the disease had gained too much headway. Spraying for pear scab was also undertaken in 1887.

In 1892 the new expert developed the plant disease part of his twin pursuit with a key to detection of plant diseases by the effects they produced,† which proved useful, and in 1893 expounded the occurrence of "root knot" on fruit trees and gave it the name "crown-gall," which has since prevailed. This was the first of a series of studies of the occurrence of the trouble and its treatment on vines and trees by other investigators of the station staff from time to time for twenty years following. Work on special plant diseases affecting the vine and the olive was also undertaken by the specialist in those fruits, and notable publications made. In 1898 this specialist who was giving instruction at that time in bacteriology identified the occurrence of olive knot or "tuberculosis" the causative organisms and its infectious character by inoculations‡ and this pest was later elaborately studied by others of the station staff. In 1901 the occurrence of brown-rot on stone fruits was identified and prescribed for.§ Other things in the plant-disease line were also incidentally pursued previous to that date.

How a real Plant Doctor was Secured.—In 1903, however, separate plant-disease work was officered and equipped by the insistence and generosity of the growers and canners of asparagus to whom the asparagus rust appeared in that year to be capable of destroying their occupation. An appeal to the Legislature of 1903 for relief funds had failed and the canners and growers furnished the money in that year to pay a qualified expert and furnish him working facilities. His demonstration of a successful treatment for this particular disease was quickly effective|| and led to farther pursuit of the work and rallied those who were menaced by the instrusion of the pear blight, walnut blight, etc., to demand investigation also with private con-

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* Cal. Sta. Bull. 51, January 15, 1886.

† Cal. Sta. Rep. 1891–92, p. 258, January 15, 1886; also Rep. 1890, p. 51.

‡ Cal. Sta. Bull. 120, March, 1898.

§ Cal. Sta. Rep. 1898–01, p. 320.

|| Cal. Sta. Circ. 9, Jan., 1904.

tribution of funds and with such insistence that the Legislature of 1905 appropriated funds for the establishment of the southern California Pathological Laboratory at Whittier, with a branch at Riverside, and funds also for plant-disease investigations in other parts of the state. Thus the plant-disease work of the station expanded into a broad, professional status and in 1907 the specialist who came to California in 1903 alone had twelve field and laboratory assistants, with laboratory and headquarters in Berkeley and two laboratories in southern California. As the asparagus rust was practically knocked out before that time, the new forces attacked pear blight, walnut blight and subsequently several obscure diseases of citrus fruits and commercial vegetables. The investigations in these lines are too many and elaborate for enumeration. The publications of results and appropriate cultural demonstrations and exhortations constituted a larger part of the printing from 1907 to 1912 than any other branch of the station work required. The plant-disease work of the period indicated was undoubtedly the most rapid and broad in development and practical achievement and most effective in popularization of the institution engaged in it of any research line which the station pursued—comparable perhaps with the attainment of the University Farm on the instructional side. It was the fundation upon which establishment of the much greater and broader undertaking, the Southern California School of Tropical Agricultural and Citrus Experiment Station at Riverside, has since arisen.

19. FERTILIZATION AND IRRIGATION

Beginning with soil studies, as previously stated, the station was brought face to face with fertilization but did not strongly tackle it because popular interest was scant and adverse to emphasis on that subject. The conception, born of the pioneers, that California soils were not only naturally rich but, climatically or otherwise, self-restorative, still widely prevailed. Though the station scouted that doctrine it was not wise to proceed aggressively with exhortations to fertilization. It was better to strike out first for definite knowledge of soil contents and that was done. Still the first field experiment (1875) included the use of fertilizers from 1878 to 1882 and on the latter year the conclusion was reached, as stated some years later:

> The fertilizers tried were potash salts, ammonia salts, sodic nitrate, phosphates, gypsum and lime.... Only the phosphates and nitrogenous manures and lime produced any consistent and sensible effect upon production. As these results agreed with the forecast

> **made in 1877 on the basis of the analysis of the soil in question, it was deemed unnecessary to proceed farther with these tests and none have been made since.***

Thus the station was established in its conviction which had been announced at the beginning, that fertilizers should be prescribed on the basis of soil analysis and this position was valiantly defended for many years. The other avenue to successful prescription of fertilizers, that is to apply to each crop or plant whatever it was shown by analysis to put into its own substance, was also diligently pursued. From 1878 for twenty years or more analyses were made of nearly all parts of all agricultural plants and their products. In 1895 the first elaborate statement of the bearing of such determinations on the practice of fertilization was made,† showing "materials taken by different crops." At the same time a vigorous protest against the untrustworthiness of "test plots" was entered and the conclusion reached that if one knew by analysis what the soil contained and what the plant required it would be as easy as "matching pennies" to prepare a fertilizer prescription! This was such a reasonable proposition that it made a profound impression on practical men, but experience did not always realize expectations based upon it. It was chiefly the citrus growers of southern California who declared the question still unsettled and they proceeded to helter-skelter applications according to their own alleged observation of results or the advice of fertilizer dealers, and they were using largely things which analyses showed to be unnecessary and getting no results from things which analyses prescribed. Two sharp demands came upon the station as the result of this confusion: first, a fertilizer-control law which would insure that a buyer would really get what he was paying for; second, actual and systematic demonstration, by applications to fruiting trees, of what would surely make them more thrifty and productive.

A fertilizer-control law had been previously urged by the station but strenuously opposed by dealers who were glad to have a commercial terminal for goods condemned at the east. The first fertilizer analysis was made in the station laboratory in 1877 and a fertilizer selling at $53 per ton was found to be worth $33. It was, however, a decade later that a little demand for such work arose and a "fertilizer control" was first claimed to be desirable.‡ In 1895 it was declared "useless to analyze fertilizers without a law to control them'' and eight years more (1903) before growers insisted upon such a law and it was enacted by the Legislature of California. The law of 1903 was held to ''provide a distinct step in advance in fertilizer laws over others then existing, in that each bag is required to have a label stating contents and source of the material in each of its forms.'' The operation of this law was satisfactory and successful, and its income features made contribution to other work of the station—as has already been cited in the discussion of buildings which the station has been able to secure.

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* Cal. Sta. Rep. 1888–89, p. 43.

† Cal. Sta. Rep. 1894–95, p. 123.

‡ Cal. Sta. Rep. 1887, p. 19.

About 1903 also orange growers in southern California insisted upon actual orchard demonstrations of the effects of fertilizers and in laying out the Riverside citrus station (under the law of 1905) plats were planted with trees of the same kind and subterraneously isolated so that water could not move substances away from trees planned to feed upon them and toward others which were given other rations.* Some important results from this equipment were obtained after the period covered by this sketch.

In this connection the work with leguminous plants for green manuring, which has been previously outlined under forage plants, may be properly cited.

Irrigation.—Though the college has taught irrigation from its foundation and though the experiment station in the course of its soil and plant work reached many conclusions which have been accepted as contributions to irrigation science and practice, neither can lay much claim to original undertakings or achievements. In 1901 the institution began an affiliation with the Irrigation Investigations Staff of the United States Department of Agriculture, coöperating cordially—even to the extent of largely allowing the general government to pay the bills accruing from the joint activities. Still the station did what it could to betoken mutuality. It cut skylights in the roof of its old building and gave a large, airy garret to the irrigators, in which they were not distracted from their work by temptation to gaze upon the landscape. It set apart land on the University Farm for irrigation experiments which the government directed and paid for. The station staff assisted in preparation of reports on irrigation for which the government also paid and published and for which it is entitled to all the credit. To investigational work in which the state of California coöperated with the United States Department of Agriculture, the University contributed its office and laboratory facilities and furnished several of the government experts with academic titles and some compensation for their participation in instruction. All this occurred during the decade previous to 1912 when extension of many undertakings made funds inadequate. The affiliation with the irrigation workers of the general government was exceedingly fortunate and laid the foundation for greater work which has been more recently undertaken.

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* Cal. Sta. Circ. 35, 1908.

20. ANIMAL INDUSTRY

Instruction in live stock subjects was begun in 1878 as a part of the "course in practical agriculture" and was continued by the picture-book and farm-visiting method until the first special instructor was installed in 1900. The early efforts at developing live stock instruction by direct contact with animals have been already outlined in the discussion on the establishment of the University Farm—because of their intimate relation to that adjunct which was chiefly secured by the insistence of the stock growers and in the equipment of which their desires had naturally the right of way. When the University Farm was fitted with the first stock buildings, animals and instructors were moved away from Berkeley and quartered on the farm—except the University Dairy, which has continued to occupy the hillside buildings and pastures with its local milk production and trade. Perhaps the item of widest public interest in connection with this branch of the Animal Industry Department is the fact that about 1907 an attorney assembled the dairymen supplying the city of Berkeley in an effort to compel the University to cease selling milk on the ground that the state should not compete with private citizens in production. The institution contended that the production of milk, the outfit to accomplish it and the proper method of delivery to customers were parts of its practical instruction which dairymen had demanded; that to keep the cattle and secure the milk and not deliver it to customers would not only be a waste of the people's property but would arrest instruction short of the final act, essential to the successful completion of the course. The case was brought in the Superior Court of Alameda County and the decision supported the University's contention. It probably also secured freedom from interference to the University Farm Creamery which was operated from its opening as a commercial creamery and was at first threatened with opposition from adjacent private creameries.

In 1901 the subject of "animal industry and dairy husbandry" first constituted a division of the annual report and a discussion of the feeding value of sugar beet pulp was undertaken on the basis of experiments. In 1904 hogs and sheep were first purchased for use in instruction at Berkeley and kept as appendages of the University Dairy. Later the University Dairy was outfitted as a "certified dairy" and operated on that basis for instructional purposes and as a demonstration for public service of a method which has since entered largely into commercial practice.

The great and gratifying development of instruction and research in animal industry on the University Farm and its achievements do not belong to this recital for the division was not adequately organized, manned and equipped until a later period. It is, however, interesting to remember that the stock-judging pavilion, the dairy barn and the creamery were constructed during 1907 and that the creamery was opened for commercial operation in September, 1908; that the horse and sheep barns, the animal industry and veterinary buildings and the first silo (concrete) were built in 1909 and 1910.

As buildings were provided for special activities in animal industry, new instructors were secured and animals of different breeds and types purchased and practical instruction diversified. On February 25, 1909, the entries for the first "educational butter-scoring contest" desired by the California Creamery Operators' Association, were made. In 1909 also the first "cow testing association" was organized, and promotion of this method of proving cows actively undertaken. In the same year courses of instruction in marketing milk and the first "Farmers Week"—a short course largely upon a live stock and dairy basis, was undertaken. In 1910 experiment and publication on advanced problems in creamery operation was undertaken, covering such topics as over-run, starter-making, coloring, acid-tests, moisture-tests, etc., and close connection with practical creamery operators was established.

Such things as these were undertaken at the University Farm in addition to the Dairy School which was held from year to year. By 1912 the University Farm was well started toward breadth and definiteness of work which has since that date been amply realized.

Veterinary Science and Practice.—It is perhaps not desirable to over-emphasize it, but it may be whispered to the public in this confidential way, that the up-to-date and all-pervading science of bacteriology entered the University of California in the medicine sack of a "cow doctor." It was surely a case in which "applied science" put one over on "science for its own sake" for although the bacterial flora was, of course, known to the pure scientists of the division of botany, they never deigned to make cultures, or as we may say, grow crops of them, for the instruction of underclassmen. And thus it came about that students took their way from the exalted structures in which pure science was domiciled, seeking instruction in bacteriology in the shade of the laurels on Strawberry creek in the abandoned "horse-shed" which had been preëmpted for veterinary uses—as has already been noted in the discussion of the buildings of the agricultural department. Nor is this all for when the State Board of Health came to the University seeking secrets of State Sanitation and assisted in establishing a department of Hygiene in this institution, it chose a graduate of the Agricultural College, who had strayed away into doctoring, for the Director of Hygiene and provided its instruction in bacteriology from the agricultural supply thereof. And thus it was that students destined in later years to supervise the internal workings of philosophers and statesmen drew their qualification from introspection of cows and poultry—and were impressed no doubt by such demonstration of an expedited theory of evolution both in mankind and in institutions.

Veterinary instruction and research in the agricultural college and experiment station were long desired and sought for, but no funds could be found for them. Gratuitous lectures were given to the students occasionally by public spirited practitioners of the old school, but nothing systematic was secured during the first quarter of a century. In 1887 a bill was introduced in the legislature to provide a competent veterinarian with equipment adequate for original investigation and to supply popular information and advice, but it failed of enactment. In 1901 provision was made from University funds and a qualified young man was secured from the New York Veterinary College, who in addition to functioning as a university instructor in bacteriology, as has been suggested above, entered vigorously into investigation of diseases of animals and poultry which were causing farmers great losses and discouragement. Hog cholera work began in 1901, and during the following two years a series of five descriptive and prescriptive circulars were issued which were of wide public interest and benefit. General effort for animal sanitation followed. In 1908 aggressive work against bovine tuberculosis became the basis for wide effort throughout the state for pure milk which resulted in enactment of many laws and ordinances. In 1911 the legislature provided $16,000 for making and distribution of immunizing serum for hog cholera. The law was approved June 21 and serum began to issue on September 1—such speed being possible because the University had risked advancement of funds and entered upon preparation previously. In the same year systematic survey of animal diseases in Imperial valley was undertaken by legislative provision. By 1912, the limit of this narrative, the veterinary division of the college had a group of experts on its staff and extended its work and influence to all parts of the state. It had established a branch upon the University Farm and provided itself with clinical and hospital facilities. It had secured the good will and coöperation of the State Veterinary Department and properly qualified local practitioners and had achieved notably for the public good during its first decade.

Nutrition.—In the matter of nutrition our university work has risen from lower animals to man by a modification of the same process already outlined for bacteriology, but less rapidly and dramatically, for mankind has always been swifter in pursuit of the philosophy of pain than of anything else which gets into it. It therefore required two decades or more for the University to rise to the importance of human nutrition while two or three years sufficed to start it on the trial of malevolent bacteria—and it may be doubted if it would have advanced even so fast as that in the case of human food had not war-service put a spur in the side of it. In this connection, of course nothing can be said of that phenomenon because it is too recent. It is altogether with preliminary work of the college of agriculture and experiment station which laid the foundation for war service, with which this writing has to do. Our nutrition work proceeded from the foresight and recognition of opportunity of a man who carried the beginnings of nutrition work along with manifold other undertakings which came upon him in his management for many years of the station laboratory in agricultural chemistry. It was therefore more reasonably evolutionary than our progress in bacteriology.

The first analysis of a "feed-stuff" in the college laboratory was to relieve the mind of a man who in 1882 was first to fill a silo in this state. He had read of silos and conceived the idea that he could get the benefits thereof by vertically boarding an old unused windmill tank-frame and filling it with green barley. Of course he killed a lot of horses and of course he supposed his neighbors had poisoned them, and of course the station could find no mineral poison, but a lot of rotten stuff which would balk the digestion of an ostrich. It was in this picturesque way that the station studies of stock foods began. It continued with more promising materials until in 1892 enough data had been secured to undertake the station's first publication on the feeding value of many California grains, mill feeds and fodders and to set forth locally for the first time the philosophy of feeding-standards, rations, etc.* As a result of this publication analyses of feeding stuffs were widely called for and much new material was published in

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* "The investigations of Cattle Foods of California," by M. E. Jaffa, Cal. Sta. Rep. 1891–92, p. 119.

1895 and in 1897 and subsequently. In 1895 also the first attack was incidentally made on human foods, through coöperation with the California Poultry Association, in determination of equal food value in brown and white shelled eggs in spite of commercial discrimination. Incidental attack continued in comparative determination of food value in eastern and California-grown dried vegetables. In 1901 the first feeding experiment was undertaken and results published.* It showed the value of beet pulp in feeding dairy cows. In 1900 work began with definite reference to human foods in coöperation with the United States Department of Agriculture chiefly to determine food value of California fruits and nuts and to test the results through dietaries practically applied—apparatus therefore being set up and fruitarian theories tested out. Publication was made by the United States Department.† Perhaps the difficulties under which these elaborate studies were pursued is the most interesting academic aspect of them. These may be indicated by the fact that the work was done in the only places which could then be found for it, viz: a corner of the main laboratory, a corner of an abandoned boiler shop and a corner of an attic lighted by a small sky light, but it proved to be work done in a corner proclaimed from a house top, and its influence has been very great and wide reaching in promotion of wholesome living and the recognition of the food value of California fruit products.

Poultry.—Combining results of the foregoing undertakings in veterinary and nutrition studies and consisting largely of them, was the earlier poultry work of the experiment station. It was entered upon at the solicitation of the poultry farmers of the Petaluma region who secured an appropriation from the legislature of 1903 to establish a poultry station, "to ascertain the causes of disease, the relative value of poultry foods, methods of sanitation and liberally to promote the poultry interests of the State." The use of land was secured, buildings erected and poultry installed. During 1903–4 the station veterinarian was chiefly employed with tuberculosis, fowl cholera, roup, chicken-pox and brooder troubles, while feeding experiments were also pursued. All these studies yielded publication of results which were widely useful. The work was continued under special appropriation by the legislature of 1905 and in 1907 the first appropriation for poultry buildings on the University Farm was made, special instructors provided and broader undertakings in all branches of poultry husbandry entered upon with additions to buildings and equipment. This work has recently been considerably extended.

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* Cal. Sta. Bull. 132.

† U. S. D. Agr. Office Ex. Sta. Bulls. 109 and 132.

21. AGRICULTURAL TECHNOLOGY

This title is introduced for a double purpose: first, to embalm the memory of an academic title which was conceived in 1897 and realized in 1904, to cover a division of instruction and research which had particularly to do with crops which passed through more elaborate manufacturing processes on their way to consumption than farm products usually do; second, to cover a few historical notes of work with such products which do not easily assemble themselves under preceding categories in this sketch. The academic title itself only existed for a short time inviolate, because popular demand emphasized phases which were clearly agronomical and "agricultural technology" fell in behind "experimental agronomy" in the incumbent's titular emblazonry and the ruling feature of it became cereal work which has already been covered in that connection. Still it is worth recording that the station did at one time endeavor to assemble in one division undertakings in production involving chemistry which ministered directly to activities more clearly pertaining to manufacture than to agriculture. A few of such affairs will be briefly outlined.

Sugar.—The manufacture of beet sugar was projected by the pioneers in the '50's and realized in 1870 by the actual manufacture of sugar from the beet at Alvarado on November 17 of that year*—which was the first product of its kind in the United States. Although the Alvarado factory made a sugar output almost every year thereafter, the general course of the industry was not clear, and other early enterprises had very devious courses and their problems were abundantly unloaded upon the station both by farmers and promoters. Discussions of these problems based upon analyses of local products of sugar beets began in 1877 and two years later very careful attention was given to the proposition to produce dried beets for shipment to distant factories for extraction, and the method was upheld as feasible by the station,† although discouraged by local sugar manufacturers who tried to work the early product, and never realized as a practical enterprise. In 1887 the station made a careful study of the "diffusion process" and continuously thereafter entered upon the analyses of beets produced in all parts of the State. In 1895 an especial examination of soils and beets to show the relation of alkaline soils to available sugar in the beet, explained the fact that good beets were actually grown for the Chino factory on land held to be alkaline because the chief part of the alkali was a surface efflorescence and the soil was not actually as alkaline as it looked. The station thus saved its face from farther pummeling by the practical man who scouted science because he was growing good beets on alkali when the station maintained that it could not be done! Subsequently elaborate experiments were made in the San Joaquin valley which demonstrated definitely the tolerance of the sugar beet for alkali, both from cultural and sugar-making points of view, and several publications on that line of work have been accepted as authoritative.* In 1907 demonstration was made of the equality of beet and cane sugar in delicate culinary operations, such as canning and jelly-making, in which the latter had long been held to be essential.† Various other sources of sugar than the beet were also investigated. Melon sugar, which was a pioneer dream, was shown to be impracticable in 1879. Sorghum cane was given analysis and exposition in 1882 and shown to contain from four to ten per cent of non-crystallizable sugar, while true sugar cane grown in Tulare County in that year showed 16 per cent of crystallizable sugar. On the whole the sugar beet was held for thirty years to be alone worth consideration in California as a trustworthy source of sugar and a proper foundation for the industry which has been developed upon it.

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* Cal. Sta. Bull. 149, by G. W. Shaw.

† Cal. Sta. Rep. 1880, p. 36.

Tobacco.—The industrial ignis fatuus, tobacco production in California which has been followed by thousands of men with millions of money during the last seventy years naturally attracted the attention of the station from time to time but without real illumination of the local problem of production except by the demonstration that California grown tobaccos have content of nicotine comparable with tobaccos grown elsewhere and are, therefore, in that respect, of good quality.‡ No suggestion of curing processes which would produce a satisfactory commercial product profitably to the grower proved to be efficient and the station was forced to use its most dearly cherished samples for bug-killing.

Textiles.—The reputation of the California experiment station rests upon no corner stone of prophecy so securely as it does upon its prediction that cotton production would ere long become a great industry of the state. There were ample demonstrations from previous experience that natural conditions of soil and climate favored the crop. Data from such experience were carefully gathered, correlated and associated with broad systematic determinations and deductions, and California was proclaimed in 1880 as a "cotton state"§ although earlier efforts at growing had been abandoned and there was in the year named not a pound of commercial product grown. It was nearly a third of a century later before cotton production became established in the Imperial Valley and subsequently extended by the stimulus of war needs to other interior districts of the state. This cotton work was indeed not only a cornerstone of a new industry which is now (1918) promising great expansion, it was the foundation upon which the expansion of the station itself was established.*

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* Cal. Sta. Bulls. 169 and 176, 1905 and 1906.

† Cal. Sta. Circ. 33.

‡ Cal. Sta. Rep. 1897–8, p. 149.

§ U. S. Census 1880, Vol. V.

Other work of the station with textile fibers was not so influential. The production of ramie had been undertaken and abandoned before the station was established, but was revived by inventors of decorticators and other fiber extracting appliances in the later '80's. The station was inclined toward this product and gave much time to determinations and exhortations concerning it†—the result being a boom for venders of ramie plants and the filling of much ground here and there with worthless roots because no device or process came through profitably. About the same time agitation for local production of flax fiber was undertaken by manufacturers agents, and their appeals for "help to establish a new industry" induced the station to import and grow a collection of European fiber flaxes which surely grew well‡ but there was no industrial outcome, as no one wished to buy the fiber and the seed crop was not so good for oil making as the variety currently grown for that purpose. This undertaking was followed by a related one to grow the oil flax known as "California" for both seed and fiber,§ but this gave birth to no industry. In answer to exhortation from a California lady who had observed weaving industries in Italy and proposed a new industry for California women and to furnish mats, Italian style, for olive pressing, the station imported Esparto grasses and encircled its garden with clumps of them about 1880. California women were not more disposed to weave baskets than they were to spin flax and olive presses could work better with American enclosing fabrics than with esparto mats, and so the clumps endured as curiosities around the garden until they were uprooted by military constructions in 1918. The same tragic history belongs to New Zealand flax (phormium) in our garden history though this plant serves an excellent ornamental purpose in many California parks and private gardens from the early introductions by the station. It still has industrial promise perhaps.

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* In Memoriam, E. W. Hilgard, 1916, p. 18.

† Cal. Sta. Rep. 1890, p. 177.

‡ Cal. Sta. Rep. 1887, p. 125.

§ Cal. Sta. Rep. 1890, p. 190.

A fiber of animal origin to which the station gave much attention in early days was silk. Before the station was established there were strenuous efforts to create a California silk industry which cost much money and yielded only losses and disappointments. In 1880 agitation was revived on the basis of the suitability of silk growing for a household industry. With this effort, which included state enactment and appropriation by the legislature of 1883, the station affiliated itself and coöperated with wide distribution of mulberry cuttings of several species imported and grown for that purpose. But silk growing was not profitable after the state ceased to buy cocoons at a high price for promotion purposes. It cost too much to hire labor to pick mulberry leaves and to wait upon the worms. Besides the women of the household did not like the "horrid fat worms" anyway and were not sufficiently pinched for pin money to be induced to train their affections. An elaborate experiment by the station entomologist to reduce the labor requirement, and to minister to ladylike taste by growing the worms on lettuce salad did not demonstrate the feasibility of this recourse and the station was forced to issue a special circular* to defend itself from the importunities of crank promotors by showing the impracticability of efforts to establish a silk industry under existing conditions. Continued experimentation was however definitely suggested.†

Tanning Materials.—Although California has abundance of oak tan bark, local tanners have always imported special tanning materials, chiefly perhaps sumac from Sicily and the eastern states and wattle barks from Australia. Propositions to grow home supplies of these things and perhaps to export them arose with the pioneers. The station encountered a demand for information almost at its establishment. In 1876 a resident of what is now Orange County conceived the idea that California sumacs could be abundantly gathered from our wild growths to repel the invaders. The station took it up actively: the tannin in two local species was determined and the percentage found to compare well with the eastern species but to range, in the specimens examined, somewhat lower than the Sicilian product—still the proposition to use our own sumac was considered promising. Leather was successfully tanned with it in Los Angeles but no commercial product of California sumac has ever been gathered. The same is true of wattle bark although plantations for a product of it were urged as early as 1890, and in 1907 analyses of wattle bark grown at the Santa Monica station indicated 45% of tannin as against

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* Sal. Sta. Circ. 16, June, 1904.

† Cal. Sta. Circ. 116, March, 1914.

32%—the highest Australian record. Leather was also successfully tanned with this bark in Los Angeles, and the station continued making analyses of it for several seasons.

But the most sensational advocacy of a cultivated crop for tanning purposes was that in favor of growing canaigre or "tanner's dock," a desert plant which collectors had been for some time gathering from wild growth for eastern shipment. This plant was under station study for ten years following 1890 and was the subject of several publications, but promoted plantations were not profitable and the demand since that time has been met by wild gatherings as it was previously.

Medicinal Plants.—Attention was paid for decades also to plants designed to supply the needs of medicine manufacturers. The Economic Garden had plots of scores of them, as already stated in the sketch of that historic affair. They were grown from year to year that visitors might gaze upon the raw forms of medicines which had pursued them from childhood and that the pharmaceutical botanists might have materials to illustrate their instruction in materia medica. These plants ranged from the high philanthropy of the opium poppy—

> "The flower of Mercy! that within its heart
> Doth keep a 'drop serene' for human need
> A drowsy balm for every bitter smart."

—down to the nastiness of the constituents of old fashioned vermifuge! It is hard to over-estimate the popular interest which the collection engrossed, but during the period under review it scored no cultural success, though subsequently it was productive of publications and, to a limited extent, of profitable production.

AN AFTER-THOUGHT

In the effort to recall from nearly seventy years of records, forty-three of them underlaid by personal recollection, transactions and incidents of importance and interest to later participants in the agricultural affairs of the University of California, there are, of course, gaping opportunities for omission and for misjudgment of what constitutes importance and interest. Such defects are fortunately subject to correction by reference to the complete list of the publications of the College and Station, and the index to the contents thereof, which have been expertly prepared by a colleague and published herewith. These excellent compilations will combine, with the footnotes which have been inserted in this writing, to assist the reader to greater detail, and definiteness on any subject with which he may be concerned.

Careful review of these records of action and transaction have deepened the conviction of the writer that the scores of men and women with whom he has had the pleasure and profit of association were persons of great industry and versatility and though they erected electroliers for many a "light that failed," a fact which this writing takes no pains to conceal, they really builded as well and sometimes better than they knew. Of their diligence and devotion to the upbuilding of agriculture in the University of California, it is very trite and yet irresistible to say: "if you seek a monument, look about you!"

PUBLICATIONS OF THE AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF CALIFORNIA,

From 1877 to 1918†

A. REPORTS.

Year Published	Title
*1877.	Reports to the President of the University from the College of Agriculture and the Mechanical Arts. (For 1876-77).
*1879.	Supplement to the Biennial Report of the Board of Regents. (For 1878-79).
*1880.	Supplement No. 1 to the Report of the Board of Regents.
*1881.	Report of the Professor in charge to the Board of Regents. (Annual 1880).
*1883.	Report of the Professor in charge to the President. (For 1881-82, also called Biennial Report).
*1884.	Report of the Professor in charge to the President. (Called Biennial Report for 1883 and 1884).
*1886.	Report of the Viticultural Work during the seasons 1883-84 and 1884-85, being Appendix IV to the Report for the year 1884; with notes regarding the Vintage of 1885-86. (This report includes the time between 1882 and 1886).
*1886.	Report of the Viticultural Work during the seasons 1885 and 1886, being Appendix VI to the Report for the year 1886.
*1886.	Alkali Lands, Irrigation and Drainage in their Mutual Relations (Appendix VII to the Report for the year 1886).
*1887.	Supplement to the Biennial Report of the Board of Regents. (For 1885-86).
*1888.	Report of Experiments on Methods of Fermentation and Related Subjects during the years of 1886-87. Advance sheets from the Annual Report of 1888.
*1889.	Report of the Professor in charge to the President. (For 1887-88).
*1889.	Report of Examinations of Waters, Water-supply, and Related Subjects, during the years 1886-89. Advance sheets from the Combined reports for 1888 and 1889.
*1890.	Report of the Professor in charge to the President for the year ending June 30, 1890.
*1890.	Report on the Agricultural Experiment Stations at the University of California, with descriptions of the regions represented. Being a part of the combined reports for the 1888 and 1889.
*1892.	Report of the Viticultural Work during the seasons 1887-89, with data regarding the Vintage of 1890.
*1891.	Report of Work of the Agricultural Experiment Station of the University of California for the year 1890.
*1892.	Alkali Lands, Irrigation, and Drainage in their Mutual Relations. Appendix to the report for the year 1890.
*1893.	Report of Agricultural Experiment Stations of the University of California for the year 1891-92.
*1894.	Report of Work of the Agricultural Experiment Stations of the University of California for the year 1892-93 and part of 1894.
*1895.	Olives, Pickling Processes, etc. Appendix C to the report for 1894-95.
*1896.	Report of the Agricultural Experiment Stations for the year 1894-95.
*1896.	Report of the Viticultural Work during the Seasons 1887-93, with data regarding the Vintages of 1894-95.
*1898.	Partial Report of the Work of the Agricultural Experiment Stations of the University of California for the Years 1895-96; 1896-97.

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*Supply exhausted. †Prepared by F. W. Woll.

Year Published	TITLE
*1900.	Report of Work of the Agricultural Experiment Stations of the University of California for the Year 1897-98.
*1902.	Report of Work of the Agriculturla Experiment Station of the University of California for the Years 1898-1901, Part I.
1902.	Report of Work of the Agricultural Experiment Station of the University of California for the Years 1898-1901, Part II.
1903.	Report of the Work of the Agricultural Experiment Station of the University of California from June 30, 1901, to June 30, 1903.
1904.	Twenty-Second Report of the Agricultural Experiment Station of the University of California from June 30, 1903 to June 30, 1904.
*1913.	Report of the College of Agriculture and Experiment Station of the University of California from July 1, 1902, to June 30, 1913.
1914.	Report of the College of Agriculture and Agricultural Experiment Station of the University of California from July 1, 1913, to June 30, 1914.
1915.	Report of the College of Agriculture and the Agricultural Experiment Station of the University of California from July 1, 1914, to June 30, 1915.
*1916.	Report of the College of Agriculture and the Agricultural Experiment Station of the University of California from July 1, 1915, to June 30, 1916.
1917.	Report of the College of Agriculture and Agricultural Experiment Station of the University of California from July 1, 1916 to June 30, 1917.

B. BULLETINS.

No.	Title	Author	Date of Publications	Pages
* 1	Examination of the Water of the San Fernando Tunnel	E. W. Hilgard	Jan. '84	1
* 2	Plant Distribution	E. W. Hilgard	Jan. '84	1
* 3	Remedies for the Phylloxera; Failure of Cuttings	E. W. Hilgard	Jan. '84	1
* 4	Analysis of Tanning Materials	E. W. Hilgard	Jan. '84	1
* 5	Distribution of Plants	E. W. Hilgard	Feb. '84	1
* 6	Comparative Examination of Claret Grapes from Fresno and Livermore Valley	E. W. Hilgard	Feb. '84	1
* 7	Examination of Irrigation Waters	E. W. Hilgard	Feb. '84	1
* 8	Examination of Fertilizing Materials and Soils	E. W. Hilgard	Mar. '84	1
* 9	Examination of Zinfandel Wines	E. W. Hilgard	Apr. '84	1
* 10	Examination of Soils	E. W. Hilgard	Apr. '84	1
* 11	On the Physical and Agricultural Features of California	E. W. Hilgard	May '84	1
* 12	Examination of Zinfandel Wines	E. W. Hilgard	May '84	1
* 13	Examination of Red or Claret Wines	E. W. Hilgard	Aug. '84	1
* 14	Examination of Artesian Waters from the San Joaquin Valley	E. W. Hilgard	Aug. '84	1
* 15	Examination of Soils from southern California	E. W. Hilgard	Aug. '84	1
* 16	Entomology of the College of Agriculture	C. H. Dwinelle	Sept. '84	1
* 17	The Muscat Grape of the Southern Mesas	E. W. Hilgard	Sept. '84	1
* 18	Mr. J. A. Bauer's Phylloxera Remedy	E. W. Hilgard	Oct. '84	1
* 19	Observations on the Phylloxera made during 1884	F. W. Morse	Oct. '84	1
* 20	Examination of Stream and Well Waters	E. W. Hilgard	Oct. '84	1
* 21	Examination of Red Wines from Sonoma and Napa Counties			1

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*Supply exhausted.

No.	Title	Author	Date of Publications	Pages
* 22	University Seed Distribution	C. H. Dwinelle	Nov. '84	1
* 23	Vintage Work in the Viticultural Laboratory, 1884	E. W. Hilgard	Nov. '84	1
* 24	Examination of Grape-Growing Soils	E. W. Hilgard	Nov. '84	1
* 25	Examination of Alameda County Vineyard Soils	E. W. Hilgard		1
* 26	Examination of Miscellaneous Vegetable Substances	E. W. Hilgard	Dec. '84	1
* 27	Examination of Soils from the northern Coast Range Region	E. W. Hilgard	Dec. '84	1
* 28	Examination of Tule, Marsh and Alkali Soils	E. W. Hilgard		1
* 29	Distribution of Plants and Scions	E. W. Hilgard	Dec. '84	1
* 30	Examination of Various Upland Soils			1
* 31	Examination of Trosseau and Berger Wines	E. W. Hilgard	Jan. '85	1
* 32	Examination of Well and Spring Waters	E. W. Hilgard	Feb. '85	1
* 33	Examination of Soils and Waters	E. W. Hilgard	Feb. '85	1
* 34	Experiments on the Growth of Cuttings from Wild American Vines	E. W. Hilgard	Mar. '85	1
* 35	Investigation of Wines from rare Grape Varieties	E. W. Hilgard	Apr. '85	1
* 36	Examination of Soils and Subsoils	E. W. Hilgard	Apr. '85	1
* 37	Investigations of Wines from rare Grape Varieties—Cinsaut, Petit Bouschet, Merlot, Verdot	E. W. Hilgard	Apr. '85	1
* 38	Investigations of Wines from rare Grape Varieties—Beclan, Cabernet Franc, Cabernet Sauvignon	E. W. Hilgard	Apr. '85	1
* 39	Analyses of Oranges and Lemons from the Riverside Citrus Fair	E. W. Hilgard	May '85	1
* 40	Investigations of Wines from rare Grape Varieties—Clairette Blanche, Roussanne, Marsanne	E. W. Hilgard	May '85	1
* 41	The Olive	W. G. Klee	June '85	1
* 42	Vintage Work in the Viticultural Laboratory	E. W. Hilgard	Aug. '85	1
* 43	Analyses of Santa Clara Valley Red Wines	E. W. Hilgard	Sept. '85	1
* 44	The "Bedrock Lands" of the Sacramento Valley	E. W. Hilgard	Oct. '85	1
* 45	Grafting the California Wild Vine	J. E. Packard	Oct. '85	1
* 46	Grafting and Fruiting of Resistant Vines	Geo. Husmann		1
* 47	Seed Distribution	E. W. Hilgard		1
* 48	Investigations upon the Mercurial Phylloxera Remedy	E. W. Hilgard	Nov. '85	1
* 49	Examination of Soils from the Bay Region	E. W. Hilgard	Dec. '85	1
* 50	Distribution of Plants and Scions	E. W. Hilgard	Dec. '85	1
* 51	The Wines of 1885	E. W. Hilgard	Jan. '86	1
* 52	Alkaline Washes for Fruit Trees	E. W. Hilgard	Feb. '86	1
* 53	Irrigation, Drainage and Alkali	E. W. Hilgard	Feb. '86	1
* 54	Condensed Grape-Musk and its Uses	E. W. Hilgard	Apr. '86	1
* 55	The Woody Aphis and its Repression	W. G. Klee	May '86	1
* 56	Whale-Oil Soap Insecticide Washes. Sulfuring of Vines	E. W. Hilgard	May '86	1
* 57	Vintage Work and Instruction in the Viticultural Laboratory	E. W. Hilgard	Aug. '86	1
* 58	The Hessian Fly and Resistant Grains	E. J. Wickson	Oct. '86	1

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*Supply exhausted.

No.	Title	Author	Date of Publications	Pages
* 59	The Experimental Vineyard at Cupertino	E. W. Hilgard	Nov. ’86	1
* 60	Colorimetric Measurement of Wines	E. W. Hilgard	Dec. ’86	1
* 61	Distribution of Seeds and Plants	E. W. Hilgard	Dec. ’86	1
* 62	Distribution of Cuttings and Scions	E. W. Hilgard	Dec. ’86	1
* 63	Experiments on Methods of Fermentation	E. W. Hilgard	Jan. ’87	1
* 64	Planting and Grafting of Resistant Vines	E. W. Hilgard	Jan. ’87	1
* 65	Shall California Make Sophisticated Wines	E. W. Hilgard	Feb. ’87	1
* 66	The Principles and Practice of Pasteurizing	E. W. Hilgard	Feb. ’87	1
* 67	Misconception of the University Viticultural Work	E. W. Hilgard	Mar. ’87	1
* 68	University Distribution of Seeds, Plants, etc. Influence of the Mode of Fermentation on the Color of Wines	E. W. Hilgard	Apr. ’87	1
* 69	Wine Colors and Color Wines	E. W. Hilgard	May ’87	1
* 70	Abnormal Deposits on Vine Leaves; Mysterious Death of Vines; Remedy for the Anthracnose of Vines	E. W. Hilgard	June ’87	1
* 71	The Use of Gases against Scale Insects	F. W. Morse	June ’87	1
* 72	Sugar-Beets at Fresno. The Hessian Fly and Resistant Grains	E. J. Wickson	Aug. ’87	1
* 73	The Use of Hydrocyanic Acid against Scale Insects	F. W. Morse	Aug. ’87	1
* 74	Vintage Work and Instruction in the Viticultural Laboratory. The Choice of Resistant Stocks	E. W. Hilgard	Aug. ’87	1
* 75	Spray and Band Treatments for the Coddling-Moth. Difficult Fermentation	E. W. Hilgard	Nov. ’87	1
* 76	Distribution of Seeds and Plants	E. W. Hilgard	Dec. ’87	1
* 77	The Extraction of Color and Tannin during Red-Wine Fermentation	E. W. Hilgard	Dec. ’87	1
* 78	Report on the Establishemnt of Outlying Stations	E. W. Hilgard	Mar. ’87	1
* 79	Experiments on the Cause and Avoidance of Injury to Foliage in the Hydrocyanic Gas Treatment of Trees	F. W. Morse	May ’88	3
* 80	Progress of the Experiment Station Work	E. W. Hilgard	Aug. ’88	4
* 81	Distribution of Seeds and Plants	E. J. Wickson	Dec. ’88	3
* 82	The Lakes of the San Joaquin Valley	E. W. Hilgard	June ’89	4
* 83	The Rise of Alkali in the San Joaquin Valley	E. W. Hilgard	Nov. ’89	4
* 84	Distribution of Seeds and Plants	E. J. Wickson	Dec. ’89	4
* 85	Observation of Olive Varieties	W. G. Klee	Feb. ’90	4
* 86	Preservative Fluids for Fresh Fruits. The sulfuring of Dried Fruits	E. W. Hilgard	May ’90	4
* 87	The Conservation of Wines	E. W. Hilgard	June ’90	4
* 88	The Use of Fertilizers in California	E. W. Hilgard	Oct. ’90	4
* 89	Distribution of Seeds and Plants	E. J. Wickson	Dec. ’87	4
* 90	Fiber Plants of California	E. J. Wickson	Jan. ’91	4
* 91	Port and Sherry Grapes in California. Importation of Italian Grapes. Importation of Olives	E. W. Hilgard	Feb. ’91	9

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No.	Title	Author	Date of Publications	Pages
* 92	Notes on California Olives, their Adaption and Oils	L. Paparelli	Mar. '91	4
* 93	Investigation of California Oranges and Lemons	G. E. Colby	June '91	6
* 94	Composition of the Remie Plant. Fertilizing Value of Greasewood	M. E. Jaffa	Sept. '91	8
* 95	Distribution of Seeds and Plants	E. J. Wickson	Dec. '91	4
* 96	Sulfuring in Fruit Drying. Fig Trees at the Experiment Stations. Notes on the Persian Palms	Chas. H. Shinn	Jan. '92	2
* 97	Investigation of California Prunes, Apricots, and Peaches	E. J. Wickson		8
* 98	Distribution of Seeds and Plants	E. J. Wickson	Dec. '92	4
* 99	Root Knots on Fruit Trees and Vines	C.W.Woodworth	Dec. '92	3
*100	Investigation of the Cattle Foods of California	M. E. Jaffa	Feb. '93	7
*101	Further Examination of California Prunes, Apricots, Plums, and Nectarines	Geo. E. Colby		8
*102	Analyses of Figs and Fig Soils	M. E. Jaffa	June '93	8
*103	Distribution of Seeds and Plants	E. J. Wickson	Dec. '93	4
*104	Investigation of California Olives and Olive Oil	A. P. Hayne	Apr. '94	16
*105	The Canaigre, or Tanner's Dock. Austrailian Saltbush for Alkali Soils	E. W. Hilgard	Oct. '94	16
*106	Distribution of Seeds, Plants, and Scions	E. J. Wickson	Dec. '94	8
*107	The Russian Thistle in California	Chas. H. Shinn	May '95	16
*108	The Distribution of the Salts in Alkali Soils	E. W. Hilgard R. Loughridge	Aug. '95	14
*109	Distribution of Seeds and Plants	E. J. Wickson	Nov. '95	16
*110	The Study of Human Foods and Practical Dietetics	M. E. Jaffa	Feb. '96	19
*111	The Work of the College of Agriculture	E. W. Hilgard	Sept. '96	17
*112	Distribution of Seeds and Plants	E. J. Wickson	Nov. '96	8
*113	The Bleaching of Nuts by Dipping	E. W. Hilgard	Nov. '96	14
*114	The Causes of "Frogging" and "Bloating" of Prunes	F. T. Bioletti	Dec. '96	9
*115	Remedies for Insects and Fungi	C.W.Woodworth	Feb. '98	23
*116	The California Vine-Hooper	C.W.Woodworth	May '97	14
*117	The Control of the Temperature in Wine Fermentation	A. P. Hayes	July '97	19
*118	Distribution of Seeds and Plants	E. J. Wickson	Dec. '97	8
*119	Vine Pruning	F. T. Bioletti	Dec. '97	16
*120	The Olive Knot	F. T. Bioletti	Mar. '98	11
*121	The Conservation of Soil Moisture and Economy in the Use of Irrigation Water	E. W. Hilgard R. H. Loughridge	Aug. '98	12
*122	Orchard Fumigation	C.W.Woodworth	Jan. '99	33
*123	Olives. (Reprint from Nos. 123 and 137)	F. T. Bioletti & Geo. Colby	Jan. '97	33
*124	Lupins for Green-Manuring	J. B. Davy	May '99	31
*125	Australian Saltbush	M. E. Jaffa	May '99	30
*126	Paris Green for the Codling-Moth	C.W.Woodworth	May '99	40
*127	Bench-Grafting Resistant Vines	F. T. Bioletti & A. M. del Piaz	'00	36
*128	Nature, Value and Utilization of Alkali Lands	E. W. Hilgard	Mar. '00	44

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*129	Report of the Condition of Olive Culture in California	A. P. Hayne	May	'00	34
*130	Preservation of Unfermented Grape-Must	F. T. Bioletti A. M. del Piaz	Aug.	'00	12
*131	The Phylloxera of the Vine	F. T. Bioletti	May	'01	14
*132	Feeding of Farm Animals	M. E. Jaffa & L. Anderson	June	'01	54
*133	Tolerance of Alkali by Various Cultures	R. H. Loughridge	Aug.	'01	40
*134	Report of Condition of Vineyards in Portions of Santa Clara Valley	F. T. Bioletti E. H. Twight	Sept.	'01	11
*135	The Potato-Worm in California	W. T. Clarke	Oct.	'01	30
*136	Erinose of the Vine	F. T. Bioletti E. H. Twight	Nov.	'01	7
*137	Pickling Ripe and Green Olives	E. T. Bioletti E. H. Twight	Dec.	'01	21
*138	Citrus Fruit Culture	J. W. Mills	Jan.	'02	46
*139	Orange and Lemon Rot	C.W.Woodworth	Feb.	'02	12
*140	Lands of the Colorado Delta in Salton Basin, and Supplement	F. J. Snow et al	Feb.	'02	51
*141	Deciduous Fruits at Paso Robles	Chas. H. Shinn	June	'02	48
*142	Grasshoppers in California	C.W.Woodworth	Aug.	'02	36
*143	California Peach-Tree Borer	C.W.Woodworth	Sept.	'02	14
*144	The Peach-Worm	W. T. Clarke	Sept.	'02	44
*145	The Red Spider of Citrus Trees	C.W.Woodworth	Nov.	'02	19
*146	New Methods of Grafting and Budding Vines	E. H. Twight	Nov.	'02	13
*147	Culture Work of the Substations	Chas. H. Shinn	June	'02	120
*148	Resistant Vines and their Hybrids	E. H. Twight	Oct.	'02	13
*149	California Sugar Industry	Geo. W. Shaw	May	'03	54
*150	The Value of Oak Leaves for Forage	W. W. Mackie	Apr.	'03	20
*151	Arsenical Insecticides	Geo. E. Colby	May	'03	37
*152	Fumigation Dosage	C.W.Woodworth	June	'03	17
*153	Spraying with Distillates	W. H. Volck	June	'03	31
*154	Sulfur Sprays for Red Spider	W. H. Volck	June	'03	11
*155	Directions for spraying for the Codling-Moth	C.W.Woodworth	Mar.	'04	20
*156	Fowl Cholera	A. R. Ward	Apr.	'04	20
*157	Commercial Fertilizers	Geo. Roberts	Apr.	'04	29
*158	California Olive Oil; its Manufacture	G. W. Shaw	June	'04	33
*159	Contribution to the Study of Fermentation	E. H. Twight Chas. S. Ash	June	'04	26
*160	The Hop Aphis	W. T. Clarke	June	'04	13
*161	Tuberculosis in Fowls	A. R. Ward	June	'04	12
*162	Commercial Fertilizers	Geo. Roberts	Dec.	'04	22
*163	Pear Scab	R. E. Smith	Dec.	'04	18
*164	Poultry Feeding and Proprietary Foods	M. E. Jaffa	Jan.	'05	29
*165	Asparagus and Asparagus Rust in California	R. E. Smith	Jan.	'05	99
*166	Spraying for Scale Insects	H. J. Quayle	Apr.	'05	24
*167	Manufacture of Dry Wines in Hot Climates	F. J. Bioletti	Apr.	'05	65
168	Observations on Some Vine Diseases in Sonoma County	O. Butler	May	'05	29
169	Tolerance of the Sugar Beet for Alkali	G. W. Shaw	May	'05	29
*170	Studies in Grasshopper Control	J. S. Hunter	June	'05	23
*171	Commercial Fertilizers (June 30, 1905)	Geo. Roberts	June	'05	29

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*172	Further Experience in Asparagus Rust Control	R. E. Smith	Jan. '06	21
*173	Commercial Fertilizers. (December, 1905	Geo. Roberts	Dec. '27	05
*174	A New Wine-Cooling Machine	F. T. Bioletti	Jan. '06	26
*175	Tomato Diseases in California	R. E. Smith	Jan. '06	16
*176	Sugar Beets in the San Joaquin Valley	Geo. W. Shaw	Jan. '06	27
*177	A New Method of Making Dry Red Wine	F. T. Bioletti	Feb. '06	36
178	Mosquito Control	H. J. Quayle	July '06	55
*179	Commercial Fertilizers. (June, 1906)	Geo. Roberts	June '06	23
*180	Resistant Vineyards	F. T. Bioletti		
*181	The Selection of Seed-Wheat	Geo. W. Shaw	Oct. '06	22
*182	Analysis of Paris Green and Lead Arsenic. Proposed Insecticide Law	Geo. E. Colby C.W.Woodworth	Dec. '06	8
*183	The California Tussock-Moth	W. H. Volck	Dec. '06	24
*184	Report of the Plant Pathologist to July 1, 1906	R. E. Smith	Jan. '07	38
185	Report of Progress in Cereal Investigations	Geo. W. Shaw	Jan. '07	47
*186	The Oidium of the Vine	F. T. Bioletti	Feb. '07	36
*187	Commercial Fertilizers. (January, 1907)	John S. Burd	Jan. '07	25
*188	Lining of Ditches and Reservoirs to Prevent Seepage and Losses	Elwood Mead B. A. Etcheverry	June '07	31
*189	Commercial Fertilizers. (June, 1907)	John S. Burd	June '07	19
*190	The Brown Rot of the Lemon	Ralph E. Smith	July '07	70
*191	California Peach Blight	Ralph E. Smith	Sept. '07	25
*192	Insects Injurious to the Vine in California	H. J. Quayle	Oct. '07	41
*193	The Best Wine Grapes for California; Pruning Young Vine; Pruning the Sultanina	F. T. Bioletti	Nov. '07	19
*194	Commercial Fertilizers. (December, 1907)	J. S. Burd	Dec. '07	22
*195	The California Grape Root-Worm	H. J. Quayle	July '08	25
*196	Eucalyptus in California	N. D. Ingham	July '08	110
*197	Grape Culture in California; Improved Methods of Wine-Making; Yeast from California Grapes	F. T. Bioletti et al.	July '08	60
*198	The Grape Leaf-Hooper	H. J. Quayle	July '08	39
*199	Bovine Tuberculosis	A. R. Ward C. M. Haring	Aug. '08	13
*200	Gum Diseases of Citrus Trees in California	R. E. Smith	Aug. '08	35
*201	Commercial Fertilizers. (June, 1908)	J. S. Burd	June '08	19
*202	Commercial Fertilizers. (December, 1908)	J. S. Burd	Dec. '08	34
*203	Report of the Plant Pathologist to July 1, 1909	R. E. Smith	Nov. '09	63
*204	The Dairy Cow's Record and the Stable	L. Anderson	Dec. '09	25
*205	Commercial Fertilizers. (December, 1909)	J. S. Burd	Dec. '09	26
*206	Commercial Fertilizers. (June, 1910)	J. S. Burd	June '10	51
207	The Control of the Argentine Ant	C.W.Woodworth	Oct. '10	29
208	The Late Blight of Celery	S. S. Rogers	Jan. '11	32

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*209	The Cream Supply	H. A. Hopper	Jan. '11	21
*210	Imperial Valley Settlers' Crop Manual	J. E. Coit & W. E. Packard	Jan. '11	13
*211	How to increase the Yield of Wheat in California	G. W. Shaw	Feb. '11	59
212	California White Oats	G. W. Shaw	Apr. '11	79
*213	The Principles of Wine-making	F. T. Bioletti	May '11	46
*214	Citrus Fruit Insects	H. J. Quayle	May '11	66
*215	The Housefly in its Relation to Public Health	W. B. Herms	May '11	31
216	A Progress Report upon Soil and Climate Factors influencing the Composition of Wheat	G. W. Shaw & E. H. Walters	June '11	23
*217	Honey Plants of California	M. C. Richter	June '11	76
*218	California Plant Diseases	R. E. Smith & E. H. Smith	June '11	148
*219	Report of Live Stock Conditions in Imperial County, California	C. L. Roadhouse	June '11	34
*220	Fumigation Studies No. 5 Dosage Tables	C.W.Woodworth	July '11	32
*221	Commercial Fertilizers. (October 1911)	John S. Burd	Oct. '11	61
*222	The Red or Orange Scale	H. J. Quayle	July '11	49
*223	The Black Scale	H. J. Quayle	Oct. '11	48
*224	The Production of the Lima Bean	G. W. Shaw & M. E. Sherwin	Nov. '11	44
225	Tolerance of Eucalyptus for Alkali	R. H. Loughridge	Oct. '11	68
*226	The Purple Scale	H. J. Quayle		19
*227	Grape Vinegar	F. T. Bioletti	'12	25
*228	Pear Thrips and Peach Tree Borer	E. L. Morris	'12	7
*229	Hog Cholera and Proprietary Foods	F. M. Hayes	Aug. '12	22
230	Enological Investigations	F. T. Bioletti	Aug. '12	93
*231	Walnut Culture in Califronia. Walnut Blight	R. E. Smith et al.	Aug. '12	27
*232	Commercial Fertilizers	J. S. Burd	Sept. '12	58
*233	Three Years' Work of the Ferndale (Humboldt County) Cow Testing Association	L. Anderson	Sept. '12	22
*234	Red Spiders and Mites of Citrus Trees	H. J. Quayle	Nov. '12	47
*235	Further Proof of the Cause and Infectiousness of Crown Gall	C. O. Smith	Dec. '12	27
*236	The Economic Value of the Western Meadowlark in California	H. C. Bryant	Feb. '13	16
*237	Pork Production under California Conditions	B. Thompson	June '13	21
*238	The Selective Improvement of the Lima Bean	G. W. Shaw	May '13	13
*239	The Culture of Tomatoes in California, with Special Reference to Their Diseases	S. S. Rogers	June '13	26
*240	Commercial Fertilizers	J. S. Burd	Sept. '13	55
241	Vine Pruning on California	F. T. Bioletti		48
242	Humus in California Soils	R. H. Loughridge	Jan. '14	43
*243	The Intradermal Test for Tuberculosis in Cattle and Hogs	C. M. Haring	Mar. '14	57
*244	Utilization of Waste Oranges	W. V. Cruess	Mar. '14	13
*245	Commercial Fertilizers	J. S. Burd	Aug. '14	53
*246	Vine Pruning in California, Part II	F. T. Bioletti	Oct. '14	51

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*247	Irrigation and Measuring Devices	(cooperation)	Jan. '15	67
*248	The Economic Value of Pacific Coast Kelps	J. S. Burd	Feb. '15	32
*249	Stock Poisoning Plants of California	H. M. Hall & H. S. Yates	Mar. '15	28
250	The Loquat	Ira J. Condit	Mar. '15	30
251	Utilization of the Nitrogen and Organic Matter in Septic and Imhoff Tank Sludges	C. B. Lipman & P. S. Burgess	Apr. '15	8
252	Deterioration of Lumber	M. B. Pratt	May '15	18
258	Irrigation and Soil Conditions in the Sierra Nevada Foothills, California	R. D. Robertson J. W. Nelson	May '15	53
*254	The Avocado in California	I. J. Condit & M. E. Jaffa	May '15	23
255	The Citricola Scale	H. J. Quayle	May '15	16
*256	Value of Barley for Cows fed Alfalfa	G. H. True F. W. Woll, et al.	June '15	20
257	New Dosage Tables	C. W. Woodworth	July '15	16
*258	Mealy Bugs of Citrus Trees	C. P. Clausen	Sept. '15	20
*259	Commercial Fertilizers	P. L. Hibbard	Sept. '15	54
*260	Availability Studies on Nitrogenous Fertilizers	C. B. Lipman & P. S. Burgess	Oct. '15	20
261	Melaxuma of the Walnut, "Juglans regia."	H. S. Fawcett	Nov. '15	13
262	Citrus Diseases of Florida and Cuba Compared with Those of California	H. S. Fawcett	'15	58
263	Size Grade for Ripe Olives	F. T. Bioletti	Jan. '16	28
264	The Calibration of the Leakage Meter	C. W. Woodworth	Jan. '16	2
265	Cottony Rot of Lemons in California	C. O. Smith	Jan. '16	21
266	A Spotting of Citrus Fruits Due to the Action of Oil Liberated from the Rind	H. S. Fawcett	Feb. '16	8
267	Experiments with Stocks for Citrus	W. W. Bonns & W. M. Mertz	Mar. '16	26
268	Growing and Grafting Olive Seedlings	F. T. Bioletti W. F. Oglesby	Mar. '16	21
*269	Phenolic Insecticides and Fungicides	Geo. P. Gray	Apr. '16	51
270	A Comparison of Annual Cropping, Biennial Cropping, and Green Manures on the Yield of Wheat	B. A. Madson	Aug. '16	14
271	Feeding Dairy Calves in California	F. W. Woll & E. C. Voorhies	Sept. '16	27
272	Commercial Fertilizers	P. L. Hibbard	Oct. '16	51
273	Preliminary Report on Kearney Vineyard Experimental Drain, Fresno County, California	W. W. Wier	Nov. '16	20
274	The Common Honey Bee as an Agent in Prune Pollination	A.H.Hendrickson	Dec. '16	4
275	The Cultivation of Belladonna in California	A. Schneider	Dec. '16	25
276	The Pomegranate	R. W. Hodgson	Jan. '17	29
277	Sudan Grass	B. A. Madson & P. B. Kennedy	Mar. '17	32
278	Grain Sorghums	B. A. Madson	Apr. '17	28
279	Irrigation of Rice in California	R. D. Robertson	May '17	20

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280	The Economical Irrigation of Alfalfa in Sacramento Valley	S. H. Beckett & R. D. Robertson	May ’17	24
281	Control of the Pocket Gopher in California	E. R. deOng	June ’17	16
282	Trials with California Silage Crops for Dairy Cows	F. W. Woll & E. C. Voorhies	Aug. ’17	24
283	The Olive Insects of California	E. O. Essig	Sept. ’17	24
284	Irrigation of Alfalfa in Imperial Valley	W. E. Packard	Sept. ’17	20
285	The Milch Goat in California	E. C. Voorhies	Sept. ’17	32
286	Commercial Fertilizers	P. L. Hibbard	Sept. ’17	52
*287	Vinegar from Waste Fruits	W. V. Cruess	Oct. ’17	20
288	Potash From Tule and the Fertilizer Value of Certain Marsh Plants	P. L. Hibbard	Nov. ’17	8
*289	Improvements in Methods of Pickling Olives	F. T. Bioletti & W. V. Cruess	Dec. ’17	8
290	The June Drop of Washington Naval Oranges	J. E. Coit & R. W. Hodgson	Jan. ’18	12
291	The Common Honey Bee as an Agent in Prune Pollination	A H.Hendrickson	Jan. ’18	24
292	Green Manure Crops in Southern California	W. M. Mertz	Feb. ’18	32
293	Sweet Sorghums for Forage	B. A. Madson	Apr. ’18	16
294	Bean Culture in California	G. W. Hendry	Apr. ’18	64
*295	Fire Protection for Grain Fields	W. Metcalf	May ’18	20
296	Topping and Pinching Vines	F. T. Bioletti & F. C. Flossfeder	May ’18	16

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* 1	Texas Fever	A. R. Ward	May ’03	7
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* 3	Hog Cholera	A. R. Ward	June ’03	6
* 4	Anthrax	A. R. Ward	June ’03	3
* 5	Contagious Abortion in Cows	James Law	June ’03	13
* 6	Methods of Physical and Chemical Soil Analysis	E. W. Hilgard	June ’03	23
* 7	Remedies for Insects	C.W.Woodworth	June ’03	19
* 8	Laboratory Method of Water Analysis	E. J. Wickson	Dec. ’03	8
* 9	Asparagus Rust	R. E. Smith	Jan. ’04	20
* 10	Reading Course in Economic Entomology	C.W.Woodworth	Mar. ’06	20
* 11	Fumigation Practice	C.W.Woodworth	Mar. ’04	27
* 12	Silk Culture	C.W.Woodworth	June ’04	6
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* 15	Recent Problems in Agriculture. What a University Farm is For		Aug. ’05	4
* 16	Notes on Seed-Wheat	G. W. Shaw	Nov. ’05	8
* 17	Why Agriculture Should be Taught in the Public Schools	A. C. True	Jan. ’06	14
* 18	Caterpillars on Oaks	C.W.Woodworth	Feb. ’06	3
* 19	Disinfection of Stables	C. M. Haring	Apr. ’06	3
* 20	Reading Course in Irrigation	Elwood Mead	Apr. ’06	7

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* 21	The Advancement of Agricultural Education	E. J. Wickson	July '06	8
* 22	Defecation of Must for White Wine	F. T. Bioletti	Aug. '06	4
* 23	Pure Yeast in Wineries	F. T. Bioletti	Aug. '06	4
* 24	Olive Picking	F. T. Bioletti		11
* 25	Suggestions Regarding Examination of Lands	E. W. Hilgard	Sept. '06	7
* 26	Selection and Preparation of Vine Cuttings	F. T. Bioletti	Sept. '06	7
* 27	Marly Subsoils and the Chlorosis or Yellowing of Citrus Trees	E. W. Hilgard	Oct. '06	4
* 28	A Preliminary Progress Report of Cereal Investigations, 1905-07	G. W. Shaw	Jan. '07	4
* 29	Preliminary Announcement concerning Instruction in Practical Agriculture upon the University Farm, Davisville, Cal	E. J. Wickson	Jan. '07	8
* 30	White Fly in California	C.W.Woodworth	June '07	16
* 31	Agriculture College and its Relationship to the Scheme of National Education	E. J. Wickson	July '07	7
* 32	White Fly Eradication	C.W.Woodworth	July '07	15
* 33	Packing Prunes in Cans. Cane Sugar vs. Beet Sugar	G. W. Shaw	Aug. '07	8
* 34	California State Farmers' Institute at the University Farm	W. T. Clarke	Oct. '07	3
* 35	Southern California Pathological Laboratory and Citrus Experiment Station	R. E. Smith	Feb. '08	11
* 36	Analyses of Fertilizers for Consumers	J. S. Burd	Mar. '08	1
* 37	Instruction in Practical Agriculture upon the University Farm, at Davis, Cal		May '08	12
* 38	The Argentine Ant in California	C.W.Woodworth	Aug. '08	11
* 39	Instruction in Practical Agriculture at the University Farm, Davis, Cal		Aug. '08	18
* 40	California State Farmers' Institute at the University Farm, Davis, Cal	W. T. Clarke	Oct. '08	4
* 41	The School of Agriculture on the University Farm, Davis, Cal		Nov. '08	6
* 42	Pacific Coast Entomological Conference and Special Short Course in Horticulture		Apr. '09	16
* 43	The School of Agriculture on the University Farm, Davis, Cal		May '09	14
* 44	Opportunities for Instruction in Dairy Industry at the University Farm, Davis, Cal		June '09	14
* 45	Announcement of Farmers' Short Courses for 1909		Aug. '09	20
* 46	Suggestions for Garden Work in California Schools	E. B. Babcock	Oct. '09	48
* 47	Agriculture in the High Schools	L. Anderson	Nov. '09	18
* 48	Butter-Scoring Contest, 1909	H. A. Hooper	'09	20
* 49	Insecticides	H. J. Quayle	Feb. '10	2
50	Fumigation Scheduling	C.W.Woodworth	Apr. '10	24
* 51	University Farm School		'10	22
* 52	Information for Students Concerning the College of Agriculture	E. B. Babcock		8

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* 53	Announcement of Farmers' Short Courses for 1910		June '10	21
* 54	Some Creamery Problems and Tests	L. M. Davis	Aug. '10	14
* 55	Farmers' Institutes and University Extension in Agriculture	W. T. Clarke	Aug. '10	4
* 56	Worthless Fertilizers	J. S. Burd	Aug. '10	2
* 57	Announcement of Farmers' Short Courses in Animal Industry and Veterinary Science		Sept. '10	13
* 58	Experiments with Plants and Soils in Laboratory, Garden and Field	F. E. Edwards	Nov. '10	35
* 59	Tree Growing in the Public Schools	E. B. Babcock	Jan. '11	19
* 60	Butter Scoring Contest, 1910	L. M. Davis	Mar. '11	27
* 61	University Farm School		June '11	19
* 62	The School Garden in the Course of Study	E. B. Babcock & C. A. Stebbins	May '11	12
* 63	How to Make an Observation Hive	L. J. Nickels	June '11	13
* 64	Announcement of Farmers' Short Courses for 1911		June '11	16
65	The California Insecticide Law	C. W. Woodworth	July '11	23
* 66	Insecticides and Insect Control	H. J. Quayle	June '11	7
* 67	Development of Secondary School Agriculture in California	E. B. Babcock et al.	Aug. '11	53
* 68	The Prevention of Hog Cholera	C. M. Haring	Aug. '11	8
69	The Extermination of Morning-Glory	F. T. Bioletti	Aug. '11	12
70	Observations on the Status of Corn-growing in California	M. E. Sherwin	Aug. '11	20
* 71	Grains Recommended for Trial	G. W. Shaw	Nov. '11	16
* 72	Salt in Cyanids	G. E. Colby & G. P. Gray	Oct. '11	2
* 73	Pure Insecticides	C. W. Woodworth	Oct. '11	2
* 74	Rice	G. W. Shaw & A. J. Gaummitz	Feb. '12	26
* 75	A New Leakage Gauge	C. W. Woodworth	Feb. '12	15
76	Hot Room Callusing	F. T. Bioletti & L. Bonnet	Aug. '11	12
* 77	University Farm School		May '12	23
* 78	Announcement of Farmers' Short Courses for 1912		June '12	23
* 79	List of Insecticide Dealers	C. W. Woodworth	July '12	22
* 80	Boys' and Girls' Clubs	E. B. Babcock et al.	Oct. '12	8
* 81	Sweet Pea Growing Clubs	F. L. Griffin	Oct. '12	16
82	The Common Ground Squirrels of California	H. C. Bryant	Nov. '12	4
* 83	Potato Growing Clubs	Agr. Education		4
* 84	Mushrooms and Toadstools	W. A. Setchell	Jan. '13	4
* 85	A Preliminary Report of a Nematode Observed on Citrus Roots and its Possible Relation with the Mottled Appearance of Citrus Trees	E. E. Thomas	Feb. '13	14
* 86	Olives in California	F. T. Bioletti		4
87	Alfalfa	W. T. Clarke		6
* 88	Advantages to the Breeder in Testing his Pure-bred Cows for the Register of Merit	Cora J. Hill	'13	2
* 89	Hog Cholera and its Prevention	C. M. Haring	'13	4
* 90	Tuberculosis in Cattle and Hogs	C. M. Haring	'13	4
* 91	Disinfection of the Farm	C. M. Haring	'13	3

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* 92	Infectious Abortion and Sterility in Cows	C. M. Haring	'13	4
* 93	Bean Growing Clubs	F. L. Griffin	Mar. '13	8
* 94	The Dairyman's Relation to Quality	L. M. Davis		2
* 95	Detecting Dairy Losses	L. M. Davis		2
* 96	Pork Production	J. I. Thompson		2
* 97	Increasing Dairy Profits	H. E. Van Norman		1
* 98	Plowing and Cultivating Soils in California	C. B. Lipman		4
* 99	Hatching and Rearing of Chicks	J. E. Dougherty	June '13	20
*100	Pruning Frosted Citrus Trees	J. E. Coit	June '13	4
*101	Codling Moth Control in the Sacramento Valley	C. W. Woodworth	June '13	4
*102	The Woolly Aphis	C. W. Woodworth	June '13	4
*103	Chemical Analyses of Waters		June '13	2
*104	The Amended Insecticide Law	C. W. Woodworth	Aug. '13	10
*105	Analyses of Insecticides for Users	G. P. Gray	Aug. '13	6
*106	Directions for using Anti-Hog-Cholera Serum	J. F. Mitchell	Sept. '13	14
107	Spraying Walnut Trees for Blight and Aphis Control	R. E. Smith et al.	Oct. '13	8
*108	Grape Juice	F. T. Bioletti	Oct. '13	12
109	Community or Local Extension Work by the High School Agricultural Department	W. G. Hummel	Jan. '14	31
110	Green-Manuring in California	C. B. Lipman	Dec. '13	3
111	The Use of Lime and Gypsum on California Soils	C. B. Lipman	Dec. '13	4
*112	The County Farm Advisor	B. H. Crocheron	Jan. '14	12
113	Announcement of Correspondence Courses in Agriculture	W. G. Hummel	Apr. '14	12
114	Increasing the Duty of Water	B. A. Etcheverry	Feb. '14	8
115	Grafting Vinifera Vineyards	F. T. Bioletti	Feb. '14	8
*116	Silk Worm Experiments	C. W. Woodworth	Mar. '14	4
117	The Selection and Cost of a Small Pumping Plant	B. A. Etcheverry	Apr. '14	30
*118	The County Farm Bureau	B. H. Crocheron	June '14	18
119	Winery Directions	F. T. Bioletti	Sept '14	8
*120	Potato Growing in the San Joaquin and Sacramento Deltas of California	W. G. Shaw	Sept. '14	11
*121	Some Things the Prospective Settler Should Know	T. F. Hunt, et al.	Oct. '14	63
*122	The Management of Strawberry Soils in Pajaro Valley	C. B. Lipman	Oct. '14	4
*123	Fundamental Principles of Co-operation in Agriculture	G. H. Powell	Oct. '14	15
124	Alfalfa Silage for Fattening Steers	G. H. True F. W. Woll, et al.	Jan. '15	4
*125	Aphids on Grain and Cantaloupes	C. W. Woodworth	Jan. '15	4
126	Spraying for the Grape Leaf-hopper	H. J. Quayle	Mar. '15	6
127	House Fumigation	C. W. Woodworth	Mar. '15	4
128	Insecticide Formulas	C. W. Woodworth	Apr. '15	7
129	The Control of Citrus Insects	H. J. Quayle	May '15	35
*130	Cabbage Growing in California	S. S. Rogers	June '15	22
131	Spraying for Control of Walnut Aphis	A. R. Tylor	June '15	11
*132	When to Vaccinate against Hog Cholera		June '15	4

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133	County Farm Advisor	B. H. Crocheron	July '15	8
*134	Control of Raisin Insects	F. T. Bioletti	July '15	11
135	Official Tests of Dairy Cows	F. W. Woll & Cora .J Hill	Aug. '15	10
136	Melilotus Indica	W. M. Mertz	Aug. '15	4
137	Wood Decay in Orchard Trees	Wm. T. Horne	Sept. '15	12
138	The Silo in California Agriculture	F. W. Woll	Sept. '15	23
139	The Generation of Hydrocyanic Acid Gas in Fumigation by Portable Machines	H. D. Young		8
140	The Practical Application of Improved Methods of Fermentation in California Wineries during 1913 and 1914	W. V. Cruess F. T. Bioletti	Oct. '15	14
*141	Standard Insecticides and Fungicides vs. Secret Preparations	G. P. Gray	Oct. '15	4
142	Practical and Inexpensive Poultry Appliances	J. E. Dougherty & W. E. Lloyd	Nov. '15	22
143	Control of Grasshoppers in Imperial Valley	W. E. Packard	Nov. '15	11
144	Oidium or Powdery Mildew of the Vine	F. T. Bioletti & F. Flossfeder	Dec. '15	11
*145	Suggestions to Poultrymen concerning Chicken Pox	J. R. Beach	Dec. '15	8
*146	Jellies and Marmalades from Citrus Fruits	W. V. Cruess	Jan. '16	8
147	Tomato Growing in California	S. S. Rogers	Feb. '16	12
148	"Lungworms."	Wm. B. Herms & S. B. Freeborn	Mar. '16	8
*149	Lawn Making in California	J. W. Gregg	Mar. '16	8
*150	Round Worms in Poultry	W. B. Herms & J. R. Beach	Apr. '16	7
151	Feeding and Management of Hogs	J. I. Thompson	May '16	10
152	Some Observations on the Bulk Hand-of Grain in California	B. H. Crocheron, et al.	June '16	24
153	Announcement of the California State Dairy Cow Competition, 1916-18	F. W. Woll	July '16	8
154	Irrigation Practice in Growing Small Fruits in California	W. A. Hutchins	July '16	35
155	Bovine Tuberculosis	C. M. Haring	Sept. '16	19
156	How to Operate an Incubator	J. E. Dougherty	Oct. '16	8
157	Control of Pear Scab	R. E. Smith	Nov. '16	4
158	Home and Farm Canning	W. V. Cruess	July '17	32
*159	Agriculture in Imperial Valley	W. E. Packard	Jan. '17	71
160	Lettuce Growing in California	S. S. Rogers	Mar. '17	16
161	Potatoes in California	J. W. Gilmore	Mar. '17	8
162	Bacillary White Diarrhoea or Fatal Septicemia of Chicks and Coccidiosis or Coccidial Enteritis of Chicks	J. R. Beach	Mar. '17	8
*163	Some Fundamental Considerations Affecting the Food Supply of the United States	T. F. Hunt	Apr. '17	13
164	Small Fruit Culture in California	A. H. Hendrickson	Apr. '17	24
165	Fundamentals of Sugar Beet Culture Under California Conditions	R. L. Adams	May '17	24
166	The County Farm Bureau	B. H. Crocheron	Aug. '17	16

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167	Feeding Stuffs of Minor Importance....	F. W. Woll	Aug. '17	8
168	Spraying For the Control of Wild Morning Glory Within the Fog Belt........	Geo. P. Gray	Sept. '17	8
169	The 1918 Grain Crop........	Thos. F. Hunt	Sept. '17	8
170	Fertilizing California Soils for the 1918 Crop........	C. B. Lipman	Sept. '17	8
*171	The Fertilization of Citrus........	W. P. Kelley	Sept. '17	8
172	Wheat Culture........	J. W. Gilmore	Sept. '17	8
*173	The Construction of the Wood-Hoop Silo........	J. B Davidson J. E. Stiles	Sept. '17	16
174	Farm Drainage Methods........	W. W. Weir	Sept. '17	32
175	Progress Report on the Production and Distribution of Milk........	Elwood Mead	Oct. '17	16
176	Hog Cholera Prevention and the Serum Treatment........	P. T. Peterson	Oct. '17	16
177	Grain Sorghum Seed........	E. B. Babcock	Oct. '17	8
*178	The Packing of Apples in California....	W. P. Tufts	Oct. '17	32
179	Factors of Importance in Production of Milk of Low Bacterial Count....	C. L. Roadhouse	Oct. '17	12
180	Selecting Corn Seed........	E. B. Babcock	Oct. '17	8
181	Control of the California Ground Squirrel........	Jos. Dixon	Nov. '17	16
182	Extending the Area of Irrigated Wheat in California for 1918........	Frank Adams	Nov. '17	4
183	Infectious Abortion in Cows........	F. M. Hayes	Nov. '17	4
184	A Flock of Sheep on the Farm........	R. F. Miller	Nov. '17	8
*185	Beekeeping for the Fruit-Grower and Small Rancher, or Amateur........	G. A. Coleman	Nov. '17	12
186	Poultry on the Farm........	J. E. Dougherty	Nov. '17	4
187	Utilizing the Sorghums........	Thos. F. Hunt	Dec. '17	8
188	Lambing Sheds........	R. F. Miller & G. E. Fermery	Dec. '17	16
189	Winter Forage Crops........	P. B. Kennedy	Jan. '18	12
190	Agriculture Clubs in California........	B. H. Crocheron	Jan. '18	24
191	Pruning the Seedless Grapes........	F. T. Bioletti	Jan. '18	12
*192	Cotton in the San Joaquin Valley........	J. W. Gilmore	Feb. '18	8
193	A Study of Farm Labor in California....	R. L. Adams & T. R. Kelley	Mar. '18	76
*194	Intercropping of Young Irrigated Orchards........	R. S. Vaile	Feb. '18	12
195	Revised Compatibility Chart of Insecticides and Fungicides........	Geo. P. Gray	Mar. '18	4
196	Dairy Calves for Veal........	G. H. True & C. V. Castle	Mar. '18	8
197	Suggestions for Increasing Egg Production In a Time of High Feed Prices........	J. E. Dougherty	Apr. '18	8
198	Syrup from Sweet Sorghum........	W. V. Cruess	Apr. '18	16
*199	Onion Growing in California........	S. S. Rogers	May '18	24
200	Growing the Fall or Second Crop of Potatoes in California........	S. S. Rogers	May '18	4
201	Helpful Hints to Hog Raisers........	C. M. Vestal	June '18	8
202	County Organization for Rural Fire Control........	W. Metcalf	June '18	24

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	*Drying Winter Vegetables	Div. Viticulture		1
	*Preservation of Fresh Eggs	Div. Viticulture		1
	*Preservation of Vegetables by Salt and Fermentation	Div. Viticulture		1
	*Canning Fruit Without Sugar	Div. Viticulture		1
	*Jelly Stocks	F. T. Bioletti & W. V. Cruess		1
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	*Tomato Paste	W. V. Cruess		1
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	*The Drying of Potatoes, Sweet Potatoes, Pumpkins, Squash and Cabbage	W. V. Cruess	Aug. '17	1
	City Winter Gardening	S. S. Rogers		3
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	Precautions Against Poisoning by Johnson Grass and other Sorghums	C. M. Haring		4
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	*Prevention of Stinking Smut of Wheat and Covered Smut of Barley	W. W. Mackie	Nov. '17	2

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	Fruit Juices and Jellies, II	W. V. Cruess	Aug. '17	4
	Drying Fruit and Vegetables, III	W. V. Cruess	Aug. '17	4
	Candying Fruits Making Fruit Vinegar and Salting Vegetables, IV	W. V. Cruess	Aug. '17	4
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	The Utilization of Idle Lands for Wheat	C. G. Shaw	Nov. '17	4
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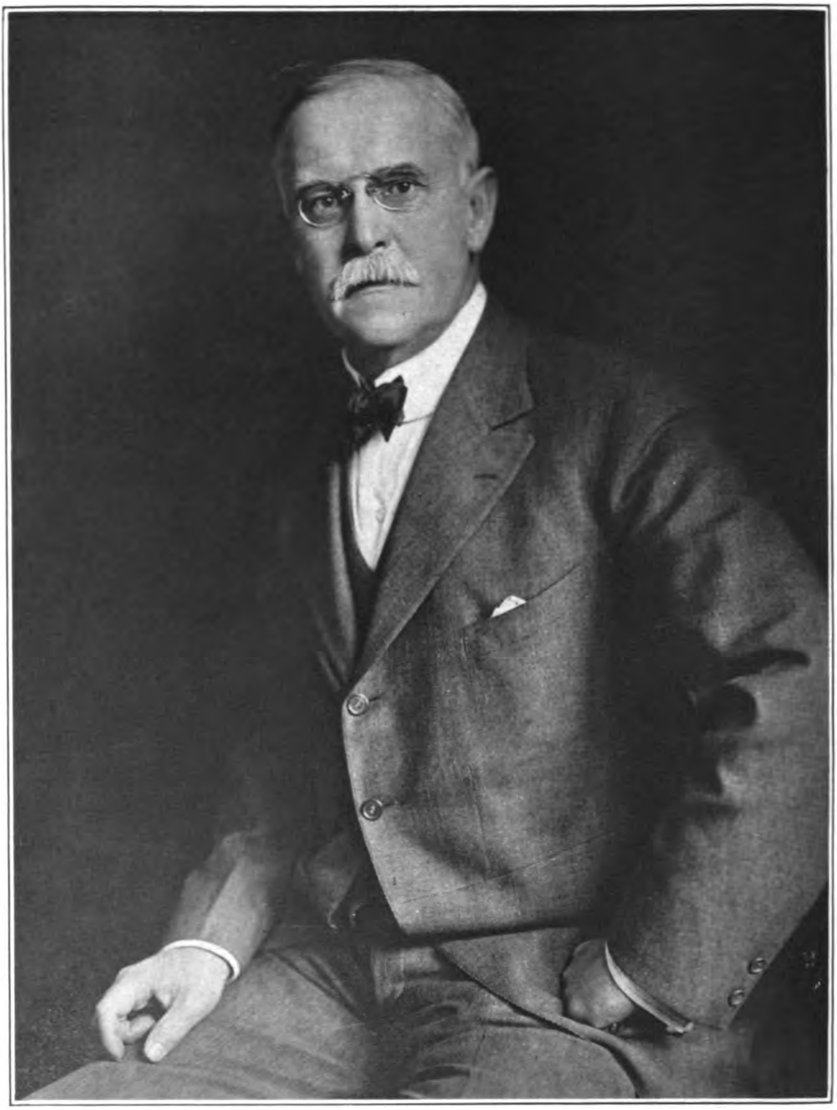

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REPORT OF THE DIRECTOR

BERKELEY, CALIFORNIA, June 30, 1919.

To the President of the University of California:

It is now nearly five years since the Germans invaded Belgium. From the standpoint of agriculture and industry, the United States has been engaged in war during that period. From the beginning, the war's influence upon the activities of this department has been discernible. It was not until two years ago, however, when a state of war was declared between this country and Germany that the work of research was seriously interrupted. There have been several factors involved. More than a score of the staff went directly into the army, in several instances applying their technical knowledge and training in the various services in which they were employed.

In the campaign for increased food production and conservation, not only was the Division of Agricultural Extension expanded through adding a considerable number of new men and women to the staff, but practically all members of the staff were engaged in promoting more or less directly the food production and conservation campaign of this department in coöperation with the United States Department of Agriculture, the United States Food Administration, and the State Council of Defense. These activities have been discussed in publications of the University and are only recalled here in order to record the fact that of the three fields of endeavor in the University of California, Department of Agriculture—research, resident instruction, and agricultural extension—the greatest emphasis has, through the exigencies of war, necessarily been placed upon its extension service.

RESULTS OF INVESTIGATION

With all the strain, anxiety and interruption incident to the world's cataclysm, progress of an important character has nevertheless been made. Summaries of results of investigation during the past three years, which include 260 items in some twenty rather distinct fields or industries, admirably illustrate the wonderful diversity of California agriculture and the great complexity of its problems. They show that its agricultural industries are more varied than those of most nations. It is not surprising, therefore, that the Federal Food Administrator for California should have repeatedly stated that California shipped to the Allies during the war more food per capita than any other state in the Union.

The Annual Report for the year ended June 30, 1916, summarized some of the results of the investigations of this station to that date. The annual report for the year ended June 30, 1918, gave a complete list of publications of the Agricultural Experiment Station, together with a subject index prepared by Professor F. W. Woll, while it contained an historical review of the activities of the college and station from the facile pen of Professor E. J. Wickson, Emeritus Professor of Horticulture, and formerly Dean and Director. The report which follows is intended to supplement the two reports mentioned, and thus enable the reader to obtain a prospectus of the work of this station. In the appendix to the report will be found a list of the bulletins and circulars published during the year, together with a list of scientific and technical papers prepared by members of the staff and published elsewhere. A list of experiment station projects is included. The lines of investigation will be indicated in some measure by the following table, although numbers of projects are not truly indicative of investigational activities, since certain single projects may be as comprehensive and important as a dozen other problems.

NUMBERS OF PROJECTS CLASSIFIED BY DIVISIONS AND SUBJECT MATTER

DIVISIONS—	New Projects	Completed or Discontinued	Data Reported	No Report
Agricultural Chemistry	0	0	0	4
Agricultural Engineering	2	0	1	7
Agronomy	0	7	5	15
Animal Husbandry	3	0	8	25
Botany	0	0	0	1
Citriculture	3	0	4	2
Citrus Experiment Station	4	0	23	10
Dairy Industry	0	0	4	6
Entomology	2	1	5	7
Forestry	0	0	5	2
Genetics	0	0	3	3
Irrigation	0	8	2	8
Nutrition	0	0	0	6
Olericulture	1	0	0	6
Plant Pathology	0	0	1	4
Pomology	2	0	6	25
Poultry Husbandry	2	1	8	2
Rural Institutions	0	0	0	1
Soil Chemistry and Bacteriology	1	0	3	3
Soil Technology	5	5	14	0
University Farm	0	0	3	2
Veterinary Science	0	0	8	6
Viticulture	0	0	15	25
	*25	*22	*118	*170

* Some of these projects are coöperative.

Results of investigations have been reported upon 118 subjects which were begun in preceding years, while 25 new projects have been organized during the year. There follows a summary of the research work of the station during the past three years.

CITRUS FRUITS

The Fertilization of Citrus Groves.—The fertilizer experiments begun in 1907 have been continued by Webber and his associates in the Citrus Experiment Station under the same plan as formerly and these uniform treatments have now been under way twelve years. The results as judged by yield and appearance of trees continue to emphasize the great importance of organic matter and nitrogen in citrus fertilization and the comparative slight importance on these soils at least of phosphoric acid and potash. The plots treated with stable manure, and raw rock phosphate on which a leguminous winter cover crop is each year grown and plowed under in early spring, continue to be superior to those otherwise treated. Plots treated with chemicals, such as nitrate of soda alone or in conjunction with sulfate of potash, superphosphate and dried blood, have gradually deteriorated, showing increased quantities of mottle-leaf and are now much inferior to plots that have received organic matter. Nitrogen and organic matter appear to stand out as the most necessary fertilizer requirements of the soil on which these experiments are located.

Experiment in the Rejuvenation of an Old Citrus Grove.—An experiment was started in the spring of 1915 for testing various fertilizers and methods of treatment in an attempt to rejuvenate a 25-year-old rundown navel orange grove. Webber and Surr report that up to date the mulched plots lead in yield, with an average crop in 1919 of 203 pounds of fruit per tree, but the trees on these plots have not, in general, a healthy appearance, many being pale and considerably mottled. The plot with alfalfa hay worked in, stands second in yield in 1919, with an average of 184 pounds per tree and the trees are not nearly so badly mottled as they were after the heavier applications of alfalfa hay in 1915 and 1916.

Next come four plots with blood, or nitrate of soda, or sulfate of ammonia alone, and one plot with complete fertilizer and manure, with an average yield in 1919 of 175 pounds per tree. Then follow a plot with complete fertilizer with 171 pounds per tree in 1919, a plot with nitrogen and potash with 163 pounds per tree, and a plot with nitrogen and phosphorus with 153 pounds per tree. Then come twelve stable manure plots, without additional nitrogen, with an average yield in 1919 of 142 pounds per tree, a plot with growing alfalfa with 131 pounds per tree, and two stable manure plots with summer cover crops and a yield of 122 pounds per tree. The steamed bone meal plot yielded only 115 pounds per tree in 1919, and the eleven unfertilized plots bring up the rear with an average yield of 93 pounds per tree. The trees on the two plots with manure and summer cover crops seem to have improved more in general appearance than the trees on any other plot, but at this writing, the trees apparently have the most healthy appearance on the plot receiving 20 cubic feet per tree of stable manure or twice as much as the other manure plots.

Green Manuring in Citrus Groves.—The further studies on the use of green manures in citrus groves, Webber and Prizer report, continue to emphasize the importance of this practice. The bitter clover *(Melilotus indica)* and the purple vetch, *(Vicia atropurpurea)* continue to give the most satisfactory results when used as winter cover crops. Another vetch, *Vicia dasycarpa,* in preliminary trials has given excellent results and may prove to be a very desirable crop. The use of purple vetch as a winter cover crop, which was introduced through the work and investigation of the Citrus Experiment Station, has not been greatly extended, owing to the shortage in the seed supply. The main supply of this seed has been produced heretofore in Oregon. Efforts have been made, in coöperation with the farm advisors to establish the growing of this seed in northern California and through the coöperation of the farm advisor in Humboldt County a good beginning in its production has this year been made in that county. The purple vetch is proving very desirable for use, especially on light sandy soils where in some cases it has been found difficult to get a good stand of *Melilotus indica.*

A feature that has been brought out in the recent experiments is the importance of using green manures in young groves to improve the soil while the grove is developing. In the 70–acre grove that was planted at the Citrus Experiment Station in the spring of 1917, an extra effort has been made to improve the soil fertility, as the land had been in grain for many years and was much run down. While the trees are small and abundant water is available, green manure crops can be grown winter and summer and plowed under very deeply to improve a considerable depth of the soil. Blackeye beans have been grown between the tree rows each summer and bitter clover sowed broadcast over the entire area in the winter. The Blackeye bean yielded the first year 720 pounds per acre of seed and about 1000 pounds of straw, and the second year 1837 pounds per acre of seed and about 3000 pounds of straw. The sale of these beans more than paid for the cultivation of this grove. Each fall, after threshing, the Blackeye bean straw has been returned to the land, being applied uniformly in furrows about twelve inches deep, plowed on each side of the tree rows, which are filled in after the straw is applied.

The winter cover crop of *Melilotus* has been allowed to grow until the latter part of March, which can be safely done in a small grove, and then plowed under, running the plow deep to distribute the organic matter thoroughly through as large a body of the soil as possible. Two such winter cover crops have been turned under. The first year this averaged about 19 tons of green material per acre and the second year about 18 tons per acre. The grove has had no other fertilizer and under this treatment has made a remarkable growth. It is doubtful whether a better two year old grove can be found in the state, even though an exhausted sterile soil was used and no application of manures of any kind has been made except the green manure grown on the land with the trees. The treatment of this grove in itself is not an experiment but it illustrates forcibly the importance of using green manures in young groves to build up the soil while the trees are young.

A Study of Stocks Used in Citrus Propagation.—The root-stock experiments conducted at the Citrus Experiment Station and described in Bulletin 267 are being continued but no new facts of importance have developed. A new phase of the root-stock problem is reported by Webber, which is of considerable interest and may suggest the desirability of giving more attention to the selection of stocks.

A large number of trees were grown at the Citrus Experiment Station for planting a grove for experimental purposes. To insure as great a uniformity of trees as possible, the seedling sour oranges to be used as stocks were carefully selected and only the large seedlings of uniform size were planted. These were then budded with Standard Washington Navel, Valencia, and Marsh seedless pomelo, the buds being taken from selected trees on which records had been kept for five years. When the buds were two years old, they were found to range in size from ⅜ inch to 1¼ inches in diameter, being nearly or quite as variable in size as in an ordinary nursery. Comparative test rows of each of the three varieties, Navels, Valencias and Marsh Seedless pomelo, were planted, using a row each of large, small, and intermediate sized buds. After two years in the orchard, these different sizes still retain their same relative sizes, the larger trees still being large; the small remain small, and the intermediate remain intermediate in size. The large trees, now four year old buds, have set considerable fruit, while the other sizes have set little or none. As the buds used in propagation were from the same selected trees, the difference seems to be in the stocks.

The sour orange seeds used for stock propagation are obtained mainly from Florida and doubtless come from many different seedling trees. A careful study of sour orange seedlings in a nursery revealed the presence of many different types. Some twenty different types were selected and trees budded from them. These buds, now four years old, show very marked differences, some being very slow growers and others very rapid ones. Evidently much of the difference in growth exhibited by budded trees even when buds were taken from selected trees, is due to differences in the stocks used. Apparently it is not enough to use merely sour stock, but a selected sour stock should be used that is known to produce uniformly good stock seedlings and to give good results when budded. A problem of the future is to select good varieties of the sour orange that can be propagated to produce seeds for growing stocks.

Doubtless the same principle will be found to apply to the sweet orange, pomelo and other citrus types when used as stocks.

Citrus Variety Studies.—For the last six years work has been progressing under the direction of Webber in bringing together for study and description as complete a collection as possible of the various citrus varieties. The variety orchard now contains about 500 different varieties and forms, of which about 125 produced fruit last year. Among the interesting introductions made by the Station, in connection with this work, are the Lui Gim Gong Orange, the Sampson Tangelo, and the Foster pink-fleshed pomelo, buds of which have been supplied to various growers for trial.

Soil Moisture Studies on Heavy Soils.—Three points were proven by Thomas from moisture studies in citrus groves on heavy types of soil.

1. Irrigation furrows should not exceed 250 or 300 feet in length for this type of soil. A uniform distribution of irrigation water cannot be obtained with furrows of a greater length (the present length is 500 to 800 feet), as the soil at the upper end of long furrows becomes water-logged if the trees at the lower end receive a sufficient amount or the soil at the lower end will become too dry if the upper end receives a proper irrigation.

Loss is caused, due to the fact that soluble plant food is carried down below the feeding root zone by the deep penetration of the water at the upper end of long furrows. The trees are damaged by the over-supply of water and their production is often lowered.

2. The interval between irrigations should be lengthened. The 30-day interval between irrigations, provided by most irrigation companies, is not well adapted to the irrigation of heavy soils. Much better results are obtained on this type of soil, by the use of a 45 or 60 day interval between irrigations. More frequent applications of water do not allow sufficient aeration for the proper development of the roots and the additional water is not required.

3. Less frequent and more thorough cultivations. The soil is often "puddled" by a cultivation too soon after an irrigation. The furrows should be leveled with a harrow as soon as the soil is sufficiently dry and it should be allowed to remain in this condition until it can be thoroughly cultivated to a depth of 7 to 9 inches. Another thorough cultivation should be given before the next irrigation. Adams, however, has reported that in heavy soils of a different character irrigations at intervals of ten days to two weeks were necessary.

The Effects of Nitrate of Soda on Soils.—The application of nitrate of soda according to Kelley, produces marked stimulation in the growth of citrus trees for a time, followed later by severe mottle-leaf. After being used annually for a period of eleven years at Riverside, the trees have become wholly unprofitable and show the most extreme symptoms of mottle-leaf. Soil studies have shown that at first calcium is set free by nitrate of soda, as a result of double decomposition, the sodium itself becoming insoluble. Other sodium salts produce similar effects. The extent to which this reaction takes place in different soils varies widely. As long as calcium is capable of being set free by nitrate of soda and the concentration of sodium does not become too great, beneficial effects are produced. But the amount of easily replaceable calcium in soils is limited and depends upon the type of soil and its previous freedom from alkali. It is usually greater on heavy types of soil than on light soil and least in very sandy soil.

The calcium made soluble by nitrate of soda is both available for growth and subject to loss by leaching. Being converted into a readily soluble form, it moves freely in soil moisture. Heavy rains and irrigations, therefore, tend to leach it below the root zone. The result is that in the course of time, the available calcium becomes reduced to a low point and further application of nitrate of soda brings about excessive concentrations of soluble sodium (alkali) in the soil moisture. Concurrently, the soil becomes greatly deflocculated, water penetrates with difficulty and aeration is retarded. At the same time, citrus trees become excessively mottled.

The Effect of Alkali on Citrus.—Hilgard and Loughridge showed more than twenty years ago that citrus trees are extremely sensitive to alkali. Recent investigations abundantly confirm their views. The symptoms of alkali injury have been found by Kelley to vary widely in different localities. Usually they include (1) burning of the margins of the leaves accompanied by defoliation; (2) mottle-leaf; (3) chlorosis; (4) yellowing of the margins of the leaves and burning of the leaf tips, especially in the case of lemons, followed by premature dropping of the leaves. In all cases, both the yield and the quality of the fruit are likely to be impaired. In extreme cases, the trees become wholly unprofitable. Lemons are more sensitive to alkali than oranges and Navels somewhat more sensitive than Valencias. No definite remedy for alkali has been discovered. Liberal applications of manure or other forms of organic matter and gypsum and heavy irrigation with good water, coupled with adequate drainage, offer the greatest promise of success.

The Composition of Citrus Leaves.—The composition of citrus leaves, Kelley states, changes extremely rapidly as growth proceeds. The young leaves contain relatively large amounts of nitrogen, phosphorus and potassium, the maximum amounts of which being deposited in the leaves during the first six to eight weeks of their growth. Later the potassium tends to remain constant until the approach of the time of normal dropping, when it decreases. A portion of the phosphorus and nitrogen, likewise, pass out of the leaves just before they normally fall. At the age of one week citrus leaves contain about equal amounts of calcium and potassium. During the next five or six weeks the calcium content increases tenfold and when the leaves have reached maturity (the calcium content) it has risen to five or more per cent of the dry weight. Later the calcium content continues to increase slowly until the time of the dropping.

Mottled leaves contain much less calcium and greater percentages of potassium, phosphorus and nitrogen, than normal leaves. Analyses of different portions of citrus trees show that under the influence of the conditions that produce mottle-leaf the tree does not secure its normal calcium supply. It appears to absorb excessive amounts of potassium instead. The abnormality in the composition of the tree is most pronounced in the leaves, but there is a tendency in the same direction in other portions of the tree.

The sap of normal citrus leaves undergoes a progressive change with age. Its concentration steadily increases and its acidity rises to a maximum point some two months from the time a shoot appears, then remains practically constant. Its calcium content continues to rise until maturity is reached. In some cases the sap of mature citrus leaves contains as much as 1.4% calcium. The potassium content is greatest in the sap of leaves six to eight weeks of age after which it decreases. The phosphorus content is greatest in the young leaves. The sap of mottled leaves, on the other hand, contains more than twice as much potassium, three times as much phosphorus and considerably less calcium, than that of normal leaves.

The hydrogen-ion content of mottled leaves is not greater than that of normal leaves, but the sap has the capacity of combining with two or three times as much base as that of normal leaves. Mottled leaves, therefore, are not more acidic than normal leaves, but they contain greater amounts of un-ionized acid-producing bodies. It seems that acidic substances are either produced in greater amounts than normally, else transfer is retarded, but the presence of so-called ''buffers'' holds ionization in check. The concentration of the sap of mottled leaves as measured by freezing-point depression and specific gravity, is considerably above the normal. The ash content of the sap is likewise higher.

The water-soluble potassium of normal citrus leaves reaches the highest point at about six to eight weeks of age, followed by a rapid decline at maturity. The water-soluble phosphorus follows the same general course as that of potassium. while the soluble calcium steadily increases up to maturity, when it equals almost 3% of the dry weight of the leaf. The soluble potassium and phosphorus of mottled leaves, on the other hand, are much higher than of normal leaves, while the calcium content is intermediate.

Pruning Orange Trees.—As a means of keeping orange trees at their maximum production, pruning is a necessary horticultural practice. Left to itself, the orange tree becomes so dense that many branches suffer from overshading, twigs die, and the tree suffers. A light annual pruning is one of the operations necessary. The value of severe pruning as a means of rejuvenating nonproductive trees has been investigated by Reed. Moderate pruning has been found to be better than severe pruning. The latter type of pruning gives the tree a set back from which recovery is slow and often uncertain. Removal of the major portion of the top of the tree exposes the trunk and main limbs to intense sunlight which often kills the buds and cambium layer. Several years are often required for such a tree to regain its former size, during which period the crop production is materially reduced on account of the loss of so much of the fruiting area. Moderate pruning of the orange tree has been found to be fully as beneficial as severe pruning and to give much larger yields of fruit.

The Production of Laterals in Fruit Trees.—The relative scarcity of laterals is a problem in training certain fruit trees. Growers have recourse to various methods of training trees in the attempt to overcome the unbranched condition. Reed and Halma have found strong evidence for the presence of a factor which controls the branching habit in the lemon, pear, and other trees. The apical portion of the shoot appears to produce a substance which travels downward in the phloem layer and prevents the development of subapical buds. If the apical portion of a young shoot be cut off, the lateral buds just below the point of amputation will grow out to form shoots because they are thereby freed from the inhibiting substance. As soon as they begin to grow, however, they form a renewed supply of the inhibiting substance and perpetuate a dormant condition in the buds below them. When an unbranched shoot is held in the horizontal position, the buds on the upper side of the shoot develop, but the lower buds do not. The inhibiting substance appears to flow along the ventral side of a horizontal shoot, thus allowing the upper buds to grow.

Statistics on the Fruit Growth of Lisbon Lemons.—Citrus fruits grow slowly in comparison with deciduous fruits. Reed has found that the fruit of the Lisbon lemon requires 7 to 14 months to come to maturity. Fruit which was set in May, June, and July came soonest to maturity. Only a small fraction of the blossoms develop into mature fruits. Approximately 50 per cent of the blossoms set fruit, 22 per cent reach a diameter of one-fourth inch, and 6.6 per cent reach the stage of maturity. A fruit set in the spring months has the best chance of survival. As the season advances the chances of survival of juvenile fruit diminishes. A bud borne on a small flowered inflorescence has a greater chance of developing into a mature fruit than one on a many-flowered inflorescence.

Diffusion of Hydrocyanic Acid Gas.—Diffusion of hydrocyanic acid under fumigation tents was determined by Quayle by confining active insects in different positions under the tent and noting the effects of the gas. When the generation of the gas was by the pot or portable generator, the greatest concentration of gas occurs in the upper half of the tent. The difference in the effect on insects at the top and bottom of the tree may be great enough to impair the general result of the fumigation. With the new method of fumigation when liquid hydrocyanic acid is used, the gas remains more concentrated in the lower half of the tree, the reverse of the conditions under the other methods of gas generation.

Shape of Citrus Trees and Fumigation Results.—It has been shown by Quayle that where citrus trees of different shapes now receive the same dosage in general practice that more effective results may be expected on a low broad tree than on a tall tree. Proportionately there is more tent surface and more volume, the two factors that determine dosage, in the case of a tall tree than in the case of a low broad tree. The taller the tree the more folds there are in a sheet tent covering a tree and these folds, which increase both the tent surface and the volume, are not accounted for in the tape measurement around the tree or in considering the tented tree as a fixed geometrical figure.

The Citrus Nematode (Tylenchulus semipenetrans).—The citrus nematode is found in all of the principal citrus districts of the state. Thomas has found it attacking twelve different varieties of citrus, including the sour and sweet orange and the pomelo, all of which are used extensively as root stocks. Up to the present time this species of nematode has not been found attacking any plant other than the citrus family.

The nematode attacks the feeding rootlets of the citrus, piercing the cell walls and breaking down the tissues. This killing of the tissues forms a ready entrance for fusarium and other fungi. The nematodes may attack all of the feeding root system of the tree, as they have been found infesting the roots within an inch of the surface of the soil and at all depths down to twelve feet below the surface.

Trees in good condition have been found slightly infested with the nematode, but whenever the infestation is severe the trees have invariably been found in a poor condition. An experiment on nursery trees planted in 16-inch pots showed, at the end of three years, that the trees which were free from nematodes were more thrifty and in better condition than those which were inoculated with the nematode. The roots of the latter were in very poor condition, few feeding rootlets being in evidence, and these were badly injured, not only by the nematode, but also by fungi.

Control measures have been carefully studied, both on nursery stock and large trees in a grove. No sucessful method of eradication has been found. Nursery stock known to be infested should not be planted, as the nematode is transported from one district to another on the roots of nursery trees.

Citrus Fruit Spots, Stains and Blemishes.—Observations and studies on various citrus fruit spots, stains and rots are more or less continuously under way by Barrett and Fawcett. Of the large variety of types of these troubles, several have been traced to definite causes. The wither-tip fungus, *Colletotrichum gloeosporioides*, is now known to be responsible for several of the stains and spots and under favorable conditions may cause a definite decay. A new spot of lemons designated ''green-pit'' has been found in limited amounts in three sections of the state. A species of fungus of the genus *Septoria* is invariably associated with the spots and is believed to be the cause. Of the several apparently non-parasitic spots observed a type designated as storage-scald has been of particular importance this season.

Variations in Colletotrichum gloeosporioides.—A variety of diseases of citrus trees and fruit are caused by the fungus *C. gloeosporioides* Penz. Some of these are known as withertip, leaf spot, anthracnose, and tear stain. The difference in degree of infection of trees and fruit in the orchard in different localities under very similar conditions, together with rather marked differences frequently seen between cultures, led to a suspicion that there might be different strains of the fungus or perhaps even different species involved. As a result of extensive cultural studies of forty-three cultures representing all the important citrus districts of southern California, one each from Texas, Florida, and Alabama, Burger found *Colletotrichum gloeosporioides* to be a polymorphic species made up of several strains. These strains give distinct cultural characteristics when grown on artificial media and are affected by their environment. Some variations in growth characteristics induced by change of medium were found to be more or less permanent. There occurred in cultures mutations which resemble strains isolated from the natural environment. These results lead one to conclude that *C. gloeosporioides* is, under natural conditions, constantly producing new types.

Pythiacystis Gummosis of Citrus.—Further experiments by Fawcett based on the previous discovery of the causal organism of Gummosis have shown not only that the disease can easily be prevented, but that it can be successfully cured when taken in time. A study of the growth-temperature relations of the causal organism, *Pythiacystis citrophthora,* referred to elsewhere, has aided in the explanation of differences in seasonal occurrence and differences in rate of enlargement of the diseased areas.

Temperature Relations of Growth in Certain Citrus Fungi.—Fawcett has investigated the growth-temperature relations of four parasitic citrus fungi, *Pythiacystis citrophthora, Phytophthora terrestria, Phomopsis citri* and *Diplodia natalensis.* The results appear to throw light not only upon some of the principles underlying the effect of temperature on growth, but also aid in an explanation of the geographical distribution and occurrance of some of the diseases produced by the fungi studied.

It was shown that the optimum temperature for the average rate of growth of a fungus was usually different, not only for different lengths of observation periods; but for periods of the same length, if these had a different time-relation to the beginning of the exposure period. In general both the optimum and maximum temperatures for growth shifted to lower temperatures for each successive observation period.

With comparatively low temperatures the growth-rate increased with the age of the cultures, with the highest temperatures, the growth-rate decreased with the age of the culture and at intermediate temperatures the growth-rate first increased then remained constant, oscillated or decreased with the age of the culture.

It was found further that the 10-degree temperature coefficient for each of the four fungi had a high value at the lowest range studied and decreased progressively through lower values to zero.

This study suggested that the use of the coefficient-temperature graphs furnish a direct method of comparing the growth-temperature relations of different organisms, no matter in what units the rates are expressed.

Psorosis (Scaly Bark) of Citrus.—The investigations of Psorosis have been directed especially to finding out the real nature and cause of the disease. While the cause has not been definitely ascertained, progress has been made in finding out certain facts regarding the nature and development of the disease. Experiments conducted by Fawcett indicate that Psorosis is transmissible from diseased to healthy trees only under certain special conditions and that the time required for the development of even a small lesion is usually very great many months or several years in extent. No trees less than five years of age have been found with the disease. Experiments in treatment have shown that the disease, in its early stages, may be controlled, but that trees which have been affected for a long period of years are not generally susceptible of being permanently cured by known methods. Many perplexing questions remain to be answered regarding this disease.

Internal Decline of Lemons.—Investigations on this important disease of lemons and closely related troubles by Barrett and Fawcett have been continued in a limited way. Contrary to statements in a former report, the typical internal decline reaches its maximum in occurrence July to September, while membraneous stain in December to February. Data collected in 1918 indicate that fruit from trees of any age and under most any condition of cultural treatment may develop these troubles. Further evidence has been secured that parasites are not concerned as causal agents.

Beginning in November, 1915, and repeated each month for one year, clusters of lemon blossoms were labeled and the development of the fruit set followed until picked. One of the purposes in mind was to see if there was any relation between time of setting and age of fruit to internal decline. Practically none of the mature fruit labeled developed the disease.

Citrus Root Rots.—The root-rots of citrus trees have been found to be more prevalent than when first reported. Two types are reported by Barrett as being most commonly found. The form which attacks the tree at the crown and penetrates into and through the heartwood has been designated as dry root-rot in distinction from Armillaria root-rot or gum disease. The other type and one more difficult to detect causes a decay of the tap and lateral roots from the terminal ends toward the trunk. As a result of the former type, trees have been seen to wilt suddenly and die within a few days, due to the sudden shutting off of the water supply. Trees affected with the second type of rot may show a slow decline for several years. Specimens of the genus *Fusarium* have been isolated from both types but have been found more consistently associated with the former. Comparative studies of the cultures still indicate that more than one species may be capable of causing the disease.

Studies on Chlorosis in Citrus Trees.—Several years of study on this problem have revealed the following facts. Chlorosis or almost complete yellowing of the leaves of citrus trees is, in all cases, connected with calcareous or limy subsoils. Lipman has formulated the following hypothesis for the cause of chlorosis in citrus and used it as a basis for the experiments explained below. The excess of lime in the form of calcium carbonate introduces in the solution around the soil particles an excess of alkalinity (hydroxylon). Under such conditions, all of the iron in the soil solution must be precipitated. This precipitation would result in a marked deficiency in that element, which is essential to the formation and activation of chlorophyll (the green coloring matter of the leaf), and hence the leaves become chlorotic. If this hypothesis be correct, a supply of iron to the yellow leaves should cause the latter to turn green. The supply cannot be given through the roots, because the large excess of calcium carbonate present in the soil would tend to precipitate even very large applications of iron salts. Attempts were therefore made to introduce the iron in the form of ferrous sulfate (copperas) into the leaves directly by spray. The leaves are not very easily penetrated by the spray, but wherever the latter entered, the yellow of the leaves turn to a normal green.

June Drop of the Washington Navel Orange.—Conservative estimates based on reliable data place the annual loss from June drop in California orange groves at $1,500,000. It is the main factor which limits profitable Navel orange production in many parts of the interior valleys of California and Arizona. A relatively small part of the drop was shown by Coit and Hodgson to be due to the fungus *Alternaria citri*, which is widely distributed and also the cause of the black rot of Navel oranges. The fruits showing the black rot represent those infected fruits which managed to survive to maturity, other infected fruits having fallen, chiefly during the months of July and August. Spraying with fungicides showed no measurable reduction of the June drop.

By far the greater part of the shedding was found to be due to a stimulus to abscission arising from daily water deficits in the young developing fruits, resulting from the asperity of the climatic conditions to which the trees are subject. Practical means of reducing the drop are recommended as follows: heavier and more frequent irrigation during the critical period, the planting of inter-crops, mulching with straw and other materials, protection by means of windbreaks, and a reduction of leaf area by moderate winter pruning. Orchardists should be on the lookout for mutant strains which are dry-heat resistant while satisfactory in other features.

Citrus Blast, a New Bacterial Disease.—The nature and identity of a new citrus disease of considerable importance to the Sacramento Valley has been established through investigations made by the Division of Citriculture. The disease was first discovered by Hodgson in 1912. H. A. Lee, a graduate student in the Division of Plant Pathology, isolated the organism in 1916 and named it as a new species, *Bacterium citrarefaciens*, the common name, citrus blast, having previously been given it by Coit. Pruning out affected twigs is only partially satisfactory in controlling the disease and spraying experiments are being planned.

Lee has shown that the germ, though easily killed by drying when exposed, will live over four months in affected cuttings, proving that the disease can be carried over summer in this way. It has been found to occur in all the citrus districts of northern California, and particularly among oranges.

Orange Marmalade.—A citrus orange product in the form of canned marmalade juice was developed by Cruess during the past three years. The juice from the boiled fruit is combined with cooked thinly sliced peel and the mixture is canned and sterilized. It is believed such a product will have great commercial possibilities because it makes it possible for housewives to make marmalade conveniently, cheaply, and without fear of failure.

A new process of making marmalade has been developed by which the time of manufacture is greatly reduced, and the flavor and color retained to much greater degree than in marmalade now produced.

SUBTROPICAL FRUITS

Chemical Analyses of Subtropical Fruits.—Several samples of guavas, sapotes and feijoas grown in southern California have been analyzed by Jaffa at the Nutrition Laboratory.

Sapotes contain about 20 per cent of sugar. Cane sugar predominates, 12 per cent of the 20 consisting of this which is the most desirable form of sugar. Two samples from different localities showed identically the same percentage of cane sugar, and the figure for invert sugar differs by less than 1 per cent. Feijoas contain a much higher percentage of water and less than 5 per cent of total sugar, the remainder of the carbohydrate content being starch. The starch figure for the sapotes, on the other hand, is less than 4 per cent.

The nutritive value of the sapotes far exceeds that of the other fruits mentioned in the table, with the exception, of course, of the avocado. This is clearly shown by the following figures representing the caloric value per pound of the edible portion of the fruits in question: Lemon guava 224 calories, strawberry guava 287 calories, sapote 483 and 440 calories, feijoas 226 and 240 calories, cactus (species of) 244 calories, avocado 984 calories. The analyses are given in the following table:

TABLE GIVING PHYSICAL AND CHEMICAL ANALYSES OF SOME SUB-TROPICAL FRUITS

Physical Analyses

Kind Fruit	Locality	No. of Fruits	Tot. wt. Grams	Seeds		Skin		Edible Portion	
				Wt.	Pr. ct.	Wt.	Pr. ct.	Wt.	Pr. ct.
Lemon Guava	So. Calif.	6	300	27.0	9.0	28.0	9.3	245.0	81.7
Strawberry G.	So. Calif.	8	76	......	....	11.0	14.4	65.0	85.6
Sapotes	Altadena	2	131	15.0	11.4	18.0	13.7	98.0	74.9
Sapotes	Whittier	2	140.5	7.5	5.3	11.5	8.1	121.5	86.6
Feijoa	Sultana	9	216.6	......	......	34.2	15.8	182.0	84.2
Feijoa	Altadena	4	191.5	......	......	19.0	9.9	172.5	90.1
*Sp. Cacti	Santa Rosa	1	146.6	5.7	3.9	57.6	39.3	83.3	56.8
†Avocado	So. Calif	1	197.4	40.0	20.2	22.5	14.1	135.8	65.7

Chemical Analyses

Kind Fruit	Water	Ash	Prot.	Fat	Fiber	Carbohydrates		
						Sucrose	Invert Sugar	Starch, etc.
	Pr. ct.	Pr. ct.	Fr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.
Lemon Guava	84.00	.67	.76	.95	5.57	....	5.45	2.60
Strawberry G.	79.42	.77	.88	.80	6.58	....	5.06	6.49
Sapotes	72.64	.44	.64	.46	1.26	12.20	8.44	3.92
Sapotes	74.74	.47	.87	.55	1.62	12.24	7.72	1.79
Feijoa	83.87	.45	1.02	.05	3.45	....	11.16	......
Feijoa	84.86	.56	.82	.24	3.35	1.58	2.66	5.93
Sp. Cacti	86.02	.43	.76	.07	.26	....	10.25	2.21
Avocado	69.16	1.26	2.08	20.10	....	....	....	7.40

* Avg. of six fruits.
† Avg. of 28 fruits.

Avocado Varieties.—Condit has continued his investigations into the history and development of the avocado industry. A check list of 140 named varieties, 54 of California and 86 of foreign origin, was published in 1917. In coöperation with a committee of the Avocado Association, eight varieties were selected as being worthy of commercial planting, an action which has been of great importance in guiding prospective growers.

The avocado varieties recommended by the committee are as follows:
For Spring, Fuerte, Spinks, Blakeman, and Lyon.
Summer, Spinks, Blakeman, Lyon, Dickinson, and Taft.
Fall, Taft, Dickinson, and Sharpless.
Winter, Sharpless, Puebla, and Fuerte.

Avocado Analyses.—About eighty samples of avocado representing a large number of varieties have been analyzed by Jaffa during the past three years. The object of the early investigation was to ascertain the oil content of avocados of the different varieties. Later investigations have shown that the oil percentage varies inversely with the size of the fruit. The average weight of ten large fruits, different varieties, is 769 grams, varying from a minimum of 626 to a maximum of 1060 grams. The average percentage of oil is 14.9, the maxima and minima being 18.5 and 13, respectively. The average weight of ten small fruits, different varieties, was 166 grams, with an average oil percentage of 27.2 the maxima and minima being 31.6 and 22.6, respectively. The average percentages of seed in the fruits whether referring to large or small fruits differed but little.

Avocado Oil.—Metabolism experiments conducted by Mattill show that the digestibility of the avocado oil is equal to that of other edible oils.

Other investigations determining the chemical constants of the oil have shown that it resembles olive oil more than any of the other edible oils.

Albro determined the chemical constants for avocado oil and compared them with those of other common edible oils.

A great deal of difficulty was experienced in extracting the oil from the fresh pulp. Pressing, centrifuging, filtering and extracting with solvents met with but little success. Enough was extracted from the fresh pulp with petrolic ether, however, to compare it with oil from the dried pulp either by pressing or extracting with solvents. The pulp was dried at 50° C. in a steam-jacketed vacuum oven for ten hours and extracted with low-boiling gasoline. The dark colored solution was filtered through animal charcoal, which removed the rather unpleasant odor, bitter taste, and resinous material. The solution was placed on a steam bath and the solvent entirely removed with a stream of CO^2 bubbled through it. The oil was then cooled to 5° C., and decanted from a white precipitate, which, if not removed by cooling, will make the oil cloudy at room temperature. The oil so obtained was of a light golden color, bland and pleasant tasting.

The chemical constants found are given in the following table:

Table Showing Chemical Constants of Avocado and Other Oils

Chemical Constants	Avocado Oil from Fresh Pulp	Avocado Oil from Dried Pulp	Olive Oil	Butter Fat	Cottonseed Oil
Iodine Value	88.0–90	85.0–88	79.0–88	26.0–38	108.0–110
Insol. Fatty Acids (Hehner Value)	....	92.5	95.0	86.5–89.8	95.0–96
Acid Value (Free Oleic Acid)	8.0–12	4.0–6	1.5–8.3	0.45–35.0	0.0
Maumene Value	....	65.0	41.5–45	....	75.0–90
Specific Temperature Reaction	....	156.0–157	89.0–94	....	169.0–170
Av. Mol. Wt. of Fatty Acids	....	282.2	280.0	255.0–267	269.0–277
Saponofication value	177.0–178	177.0–178	185.0–196	220.0–233	193.0–195
Reichert Meissl Value	3.8–4	3.8–4	0.6	25.0–32	0.95
Polenske Value	0.0	0.0	....	1.6–3.5	....
Acetyl value (Real)	....	11.3	10.6	1.9–8.6	7.6–18
Refractive Index of Oil (15.6° C.)	1.469	1.47	1.4713	1.4536*	1.4737–57
Refractive Index of Fatty Acids 40°	1.455	1.454	....	....	1.446†
Oleic Acid	82.0–85%	80.85%	70.0–75%	30.35%	....

* 40° C. † 60° C.

The Mineral Elements of the Avocado.—Analyses of the avocado heretofore published have not given any insight into the nature of the mineral matter of this fruit, merely indicating the total amount. A few years ago when a dietary or even the nutritive value of a food was discussed, it was deemed only necessary to consider the content of protein, fat and carbohydrates, and the caloric value, no special attention being paid to the mineral matter or to the value of the individual proteins and fats.

The following analysis by Albro shows that the avocado belongs to that class of foods which yields an excess of the base-forming elements. This was, perhaps, to have been inferred, but until the investigation was completed no definite conclusions could be drawn.

Analysis of the Ash of the Avocado	CO^2–Free
Silica	0.50
Phosphoric Acid	17.40
Lime	4.72
Magnesia	5.30
Iron	1.51
Aluminum	2.58
Manganese	trace
Sulphuric Acid	11.24
Chlorin	14.36
Potash	26.23
Soda	18.55
	101.89
Oxygen equivalent to chlorin	2.09
	99.80

Nearly one-half of the ash consists of soda and potash, the latter predominating. Magnesia and lime occur in comparatively small amounts, about 5% each; the phosphoric acid averaging about 17½%, with 1½% of iron.

In the ash of the cereals, nuts, meats, eggs, etc., the phosphoric acid greatly predominates. This elements is found in the avocado, on the other hand, as in other fruits, only in relatively small amounts. In view of the low content of lime, therefore, it could not be said that the avocado should be recommended as furnishing any notable supply of bone material. This, however, is not the function of the avocado. Its great value, as far as mineral matter is concerned, lies in the fact that the ash contains a predominance of bases such as sodium, potassium, magnesium, and calcium.

Another advantage which may be cited in favor of the avocado is that its content of ash is far higher than that noted for any other fruit.

The pure ash of the edible portion of the avocado shows an average content of 1.05 per cent, while those of the other fruits are as follows:

Grapes	.500	
Plums	.524	
Prunes	.565	
Apricots	.484	
Nectarines	.490	
Figs	.440	—.897 (av. .600)
Lemon	535	
Orange	.500	

The olive is not included in this list for the reason that the ash of the olive is abnormally high, due mainly to the salt with which it is pickled. The olive is a processed fruit which cannot be eaten in the fresh state and therefore does not belong to the same class as the avocado.

If we were to compare the fruits above listed and the avocado on the same water basis, or upon a water-free basis, the figures would not be so favorable to the avocado, since the avocado contains less water on the average than do most of the fresh fruits. The above statements, however, refer to the fruit as consumed and therefore it can be said that per unit weight of fresh fruit eaten, more mineral matter is ingested with the avocado than with any of the other fruits mentioned.

Cold Storage of Persimmons and Avocados.—Cold storage work conducted by Condit with several varieties of the persimmons show that the fruit can be kept satisfactorily for several months, although it is doubtful whether market demands would justify storage much after January 15. The following table indicates the length of time different varieties kept in satisfactory condition:

Fruit Variety.	30° F.	32° F.	36° F.
Hachiya (Adams)	158 days	89 days	51 days
Maru (Adams)	210 days	189 days	63 days
Hyakume (Adams)	210 days	148 days	63 days
Mikado (Adams)	210 days	118 days	30 days
Tanenashi (Adams)	170 days	98 days	30 days
Tsuru (Taft, C. P.)	106 days	44 days	28 days
Hachiya (Thales)	141 days	63 days	34 days

Avocados of the Mexican type kept fairly well for about a month, after which shriveling ensues and black, sunken spots develop, due to the slow work of a fungus.

Freezing at 30° F. or slightly lower turns the flesh of the avocado dark and renders it totally unfit for eating. Persimmon flesh is not at all injured by the same temperatures.

Fuerte avocados in the 32° room lose their normal green appearance and assume a brown, dirty color which would injure the salability. Challenge fruit held for six weeks at 32° has kept its firmness and appearance remarkably well. State of maturity undoubtedly influences the keeping quality of avocados.

Both persimmons and avocados soften much more rapidly at 36° than at 32° or 30° F.

Caprification of Figs.—The number of female Blastophagas entering a Smyrna fig in the process of caprification, as shown by the studies of Condit, depends largely upon the numbers of Capri figs and insects in the tree. The great majority of insects lose their wings when entering the Smyrna fig. Numerous Smyrna figs examined after caprification show the presence of one to four dead Blastophagas. As many as twenty dead Blastophagas have been counted inside a single Adriatic fig. Sixteen dead insects have been counted inside a single Mission fig.

Records of the issuance of insects from mature Capri figs show that the great majority issue during the first day after distribution and that very few issue after the third day.

Records of the number of insects actually issuing from capri figs include the following:

	Females	Males
Roeding No. 3	955	21
Milco	856	104
Roeding No. 1	825	42
Roeding No. 2	781	51
Markarian No. 2	778	79
Markarian No. 1	772	81
Stanford	756	43
Roeding No. 4	733	7

The highest number of galls found in any capri fig so far studied was 2272 in a seedling fig. A Roeding No. 3 fig contained 1614 galls; a Markarian No. 2, 1326 galls; a Roeding No. 2, 1278 galls; a Milco 1375 galls; Maslin 147, 1533 galls.

The female Blastophagas hover closely around the Capri or Smyrna tree and are found at distances away from the tree only when carried by wind.

Actual counts of pollen grains on female Blastophages before entering a fig showed an average of 233 grains on each antenna of seven pairs counted; on each front leg, 16 grains of six pairs counted; on each hind leg, 20 grains; on each wing, 121 grains; on each of ten insects exclusive of body, 316 grains; average number on body and appendages, 2117 grains. Counts of pollen grains after the insect entered the fig showed a very considerable reduction in the number of grains on the appendages and body. Since the wings are generally left between the scales of the eye, the pollen on the wings is of no importance in pollination.

A microphotograph of the female Blastophaga in the act of oviposition was secured and published in the Monthly Bulletin State Commission of Horticulture, September, 1918. So far as known this is the first photograph of the process ever published.

The Brown Turkey fig is noticeably changed in outward appearance by caprification. The color changes from a reddish-brown to a violet or purplish-brown with a distinct bloom. The caprified figs are somewhat larger and the flesh becomes strawberry red, rather than amber.

The most marked changes have been noted in the so-called Kadota fig grown in Tulare County as follows:

First, the color of the uncaprified Kadota is a light, golden yellow and the surface is somewhat glossy; the color of the caprified Kadota is green or yellowish green and the surface is dull. Second, the ribs on the uncaprified figs are practically absent and unnoticeable; the caprified fruit has a ribbed appearance, especially in the wilted specimens, being netted and roughened by the slightly elevated longitudinal and cross veins. Third, the meat or rind seems to be little affected in thickness or texture. Whether the naturally excellent keeping and shipping qualities are impaired by caprification has not been determined. Fourth, the color of the flesh in the uncaprified fig is pinkish amber to light strawberry red, while in the caprified fig the color of the flesh is much deeper. Fifth, the uncaprified Kadota is practically seedless, or the seeds are so small and few in number as to be hardly noticeable. The seeds in the caprified Kadota are numerous, fairly large, and, of course, fertile. Sixth, the difference in flavor is distinct, the caprified fruit being sweeter and richer. Tests of the sugar content (Balling test) were made with the following results:

Caprified figs, 35.2%; uncaprified figs, 28.4%.

Three figs were each weighed and the fertile seeds in each counted with the following results:

(1) 25.5 gr.	544 fertile seeds
(2) 31.5 gr.	412 fertile seeds
(3) 30.0 gr.	402 fertile grains

Analyses of dried Kadota figs showed the following:

	Caprified	Uncaprified
Water	22.57 per cent	25.75 per cent
Total sugar	75.36 per cent	68.16 per cent

The Pomegranate.—A bulletin on the pomegranate* by Hodgson has called attention to the varied uses of the fruit and to its cultural requirements. The plant is particularly adapted to the heavier soils and to the arid climate of the interior valleys. The great possibilities of the fruit in the soft drink trade are emphasized since the juice, when sterilized in its natural form and preserved in bottles, is of excellent quality and in the opinion of many equal to the best grape juice.

The Fig.—As a result of careful studies by Condit the identity of the so-called Kadota fig has been established. It was introduced into California in 1889 under its true name, Dottato, and has since been widely disseminated in southern California and now forms the principal variety for fresh fruit shipping, canning, and preserving in the San Joaquin Valley. Notes on edible figs show that at least 159 varieties have been or are now being grown in some parts of the state. Descriptions and photographs of the first and second crop figs, caprified and uncaprified specimens, are gradually being secured and furnish an invaluable aid to the identification of varieties submitted by growers.

The causes of the splitting of Smyrna figs received considerable attention and is attributed to abnormal water relations in the fruit and leaves brought on by irregular moisture in the soil or atmosphere. The splitting, due to atmospheric conditions, can hardly be remedied unless non-splitting types can be developed. Soils with a high and variable water table should be avoided for the culture of Smyrna figs.

Investigations show that the value or efficiency of a variety of capri fig depends upon the following considerations: the number of female insects developed from the galls; the amount of viable pollen produced; the season of maturity, early profichi figs being most valuable; the abundance and size of the profichi figs; the relative abundance of the mammoni and mamme figs; hardiness of the mamme crop; and the pulpines of the profichi figs.

Condit and H. J. Stevens have found that there are two fungi connected with "die back" of fig branches. One form, accompanied by sporulating pustules on the outer bark is caused by *Botrytis cinerea;* the other, characterized by the presence of sclerotia in the central pith and by a shreddy condition of the bark is caused by a *Sclerotinia,* probably *S. libertiana.* The first is the most serious under California conditions. Diseased twigs should be kept pruned out and destroyed.

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* Bulletin 276, January, 1917.

The Kaki or Oriental Persimmon.—Studies of the Kaki or Oriental persimmon have been continued by Condit especially along the lines of variety nomenclature which has always been very confusing. The identity of the Hachiya, Tanenashi, Hyakume, and other commercial varieties has been established and illustrations secured. A mass of data concerning the persimmon industry has been accumulated and prepared for publication.

Caprification of the Adriatic Type of Fig.—Specimens of Adriatic figs received from Fresno in September, 1917, according to Condit, showed numerous fertile seeds, actual counts being as follows: 892, 920, 655, 1288, 820, 472, 522, 538, 907, 1527, 630 seeds in individual figs. A single Mission fig contained 128 fertile seeds; another 286. A caprified Kadota fig contained 667 fertile seeds; a White Ischia, 1180; a Black San Pedro, 1448; and a Brown Turkey, 1382.

Caprified Adriatic figs do not show very marked exterior changes in color and appearance from the uncaprified figs. The interior differences, however, are very marked. The center of the uncaprified figs is hollow; of the caprified figs, solid, or nearly so. The pulp of the uncaprified figs is of a light strawberry color; of the caprified figs, deep strawberry red. Caprified figs retain a light greenish color while drying; uncaprified figs assume a brownish straw color. Caprified figs show a sugar content of 57.15 degree. Balling; uncaprified, of 54.00 degree, Balling.

Pomegranate Juice.—It has been shown by Cruess that a delicious fruit juice of attractive appearance can be made from California pomegranates. It is improved by the addition of sugar or blending with grape juice. A mechanical method has been devised for separating the astringent fibrous parts of the fruit from the juice of the pulp. This removes one of the greatest difficulties of manufacture.

DECIDUOUS FRUITS

Pollination of Almonds.—Continued studies by Philp have confirmed previous reports, namely, that all almond varieties are self-sterile and a few are inter-sterile. A preliminary report on this project, covering five years' investigations, has been issued as Bulletin No. 306 by Tufts.

Pollination of Apricots.—Results of two years' tests with apricots, including Blenheim, Royal, Tilton, and Hemskirke varieties show that apparently the apricot is sufficiently self-fertile to make inter-planting for purposes of cross-pollination unnecessary.

Pollination of Cherries.—Further studies with cherries by Philp confirm previous results, that the following list of sweet cherry varieties under California conditions are self-sterile:

Advance, Bing, Black Heart, Black Republican, Black Tartarian, Burbank, Burr (Seedling), Chapman, Early Purple, Lambert, Mezel, Napoleon, Pontiac, Rockport, and Wood (Gov.).

Inter-sterile varieties previously reported by Tufts as a result of experiments in California, and by Gardner of Oregon, are Bing, Napoleon and Lambert. Further experiments confirm these results for California. It has also been found that Pontiac and Black Tartarian are inter-sterile. During the seasons of 1917–18–19 Rockport and Advance were found to be inter-sterile.

Pollination of Pears.—Experiments have been carried on for four years by Tufts and Philp of the Division of Pomology, both in the Sacramento Valley and in the Sierra foothills. A preliminary report has been given in Bulletin 307. In the valley, four years' results with the Bartlett show that much heavier crops are produced where the trees are cross-pollinated. The yield of Bartlett pears was sometimes increased four or five times by proper cross-pollination.

While profitable crops are sometimes secured without cross-pollination, better crops could be produced with cross-pollination. Any variety having the same blooming season as the Bartlett will apparently serve as a pollinator.

In 1918 the June drop in pears was largely prevented by cross-pollination, only 20% dropping, while 48% dropped where they were self-pollinated.

During the season of 1919, thirteen varieties of pears, including the Bartlett, were tested for self-sterility. All varieties tested were found to require or were benefited by cross-pollination.

In the Sierra foothills, the Bartlett in most years is practically self-sterile, and to secure satisfactory yields it is necessary to provide for cross-pollination.

Pollination of Plums and Prunes.—Pollination experiments with plums and prunes, by Hendrickson, covering a period of five years, were carried on in the Sacramento, Santa Clara, and Vaca valleys. The Japanese varieties Combination, Kelsey, Satsuma, Burbank, Wickson, Sultan and Abundance were found to be self-sterile. The Climax is evidently self-fertile, or at least partly so. Among the European plum and prunes Clyman, Tragedy and Robe de Sergeant, are clearly self-sterile. Imperial, although occasionally setting fruit with its own pollen, is too uncertain to be classed commercially as anything but self-sterile. Grand Duke is probably self-sterile. Pond and Yellow Egg were tested for sterility for only one year, so definite conclusions cannot be drawn. The French (Agen) and Sugar prunes are undoubtedly self-fertile. No case of inter-sterility, either in the Japanese or the European plums was found. The Japanese plums effectively cross-pollinate one another if the blooming periods occur approximately on the same dates. The same holds true for the European plums.

Pollination of Apples.—Pollination work with Yellow Newtown and Yellow Bellflower apples by Overholser in the orchard of Carrol Rodgers at Watsonville in 1919 gave the following results:

Yellow Newtown apples self-pollinated by hand (enclosed in pollination sacks), resulted in a set of 8.93% of the blossoms. When self-pollinated by bees (a hive of bees enclosed with the tree under a tent of mosquito netting), a set of 18.62% resulted. This indicates that the Yellow Newtown is sufficiently self-fertile to set a fair crop of fruit through the agency of its own pollen.

Yellow Bellflower apples self-pollinated by hand, resulted in the setting of no fruit; when self-pollinated by bees, 1.45% of the flowers set fruit. This indicates that the Yellow Bellflower is not sufficiently self-fertile to set paying crops of fruit without the agency of pollen of another variety of apple.

Yellow Bellflower hand pollinated with Yellow Newtown pollen, resulted in 1.15% of the flowers setting fruit; Yellow Bellflower pollinated with Yellow Newtown pollen through the agency of bees, resulted in 4.31% of the blossoms setting fruit. This indicates that Yellow Bellflower is capable of producing some fruit when pollinated with Yellow Newtown, but that the set under these conditions is not large enough to insure a full crop.

Yellow Newtown when pollinated by Yellow Bellflower by hand or through the agency of bees, gave a set of approximately 50% of the flowers. This indicates that while the Yellow Newtown is self-fertile, its fruitfulness is increased almost four times when crossed with Yellow Bellflower, as compared with self-pollination.

Results show that apples set fruit much more abundantly if hives of honey bees are placed in the orchard to supplement natural pollinating agencies. The normal set of Yellow Newtown in the orchard was 29.6% of its flowers, which is unusually high. The set resulting where honey bees were provided, was 47.53% for trees adjacent to the hives. The presence of the bees adjacent to the trees nearly doubled the setting of fruit.

Where insects were excluded from the trees by encasing the latter with mosquito netting tents, the Yellow Newtown set only .02% and the Yellow Bellflower .03%. This indicates that apples are practically dependent upon the agency of insects to carry the pollen and to secure a set of fruit. While insects or honey bees kept in the general neighborhood may enable the trees to set a fair crop, the set is shown to be much heavier if hives of honey bees are placed at intervals in the orchards so as to insure the present of an abundance of insect agents.

Fundamental Problems in Pollination.—Wood has carefully studied the causes of self-sterility in certain fruits, particularly the almond. After making careful examinations of pollen, conducting numerous germination tests, and studying the condition of the pistils and the mechanics of pollination and fertilization, it was found that in some cases there is no germination of pollen on the pistil unless there is a proper amount of sugar solution present. A well-known self-sterile variety of almond, the Ne Plus Ultra, was actually made to set 30% of fruit from its own pollen by previously applying to the pistils a 3% sugar solution. This is as good, or better, than the number set by this variety under first-class conditions for cross-pollination.

Pruning Deciduous Fruit Trees.—Four years' experiments by Tufts in pruning to shape young deciduous fruit trees have yielded some very definite results. Light pruning, particularly light heading back, produces larger, healthier and stockier trees than heavy heading back. Light pruning of young trees favors an abundant growth of healthy foliage and rapid increase in size, thus enabling such trees to come into bearing at three to four years of age. This early fruiting in no way injures the future usefulness of the tree. Proper spacing of branches can be brought about by timely attention to the pinching back of undesirable branches when they are only two or three inches long during the early part of the first growing season. During the second season, in early summer where trees are making a vigorous growth, a year's time in shaping the top may be gained by topping the main upright branches at a height of fourteen to thirty inches, depending upon the growth and the habits of the variety. Climax plum trees, lightly pruned, during their third season in the orchard yielded one crate per tree and two crates each the following season. Similar trees pruned heavily according to current practice, yielded no fruit the third season and less than a half crate each during their fourth season.

Late summer pruning of almonds, apricots, cherries, peaches, pears, plums, and prunes has resulted in a marked decrease in the size and vigor of the trees.

Pruning Old Deciduous Trees.—After seven years of heavy annual heading back, Royal and Tilton apricot trees were merely thinned out by opening out the center of the head and removing all interfering branches, no heading back being done at all. These trees have now gone for four years without being headed back, but are judiciously thinned each winter. The yield on the lightly pruned trees has been increased from two- to five-fold, as compared with similar trees receiving heavy annual pruning; this heavy fruit production has not decreased the size of the individual fruits below commercial limits, and has not injured the vigor of the trees except in cases where there was a shortage of irrigation water. An ample supply of water for irrigation is necessary if trees are to be expected to mature heavy crops of fruit of good size without lowering their vigor.

Almond Production Problems.—Continued studies by Taylor on the requirements, methods, limits and costs of production have brought together much material from practically every almond-producing section of the state. The results of the investigation, covering a period of six years, have been published as Bulletin 297.

Storage of Fruit.—Experiments conducted by Taylor in our storage plant indicate that the optimum temperature for the most rapid ripening of Bartlett pears, is between 70° and 80° F. The ripening process of pears at higher temperatures was delayed in a similar way but to a less degree than when pears were held at a temperature of 32° F. Pears of the same lot which ripened fully in one week when held at a temperature of 70 to 80° F. kept well for a period of from 4 to 6 weeks when held in a temperature of from 100 to 110° F. This result if generally true is of much interest to fruit growers who have heretofore supposed that the higher the temperatures, the more rapidly the fruit would ripen. Heretofore, during an abnormally warm season, pear growers have thought it necessary to pick the fruit earlier than would have been desirable in a season of normal temperature. As a result, premature picking has sometimes been practiced before the fruit reached the best stage of development. A knowledge that unusually high temperatures delay ripening, would enable the grower to delay picking slightly when the weather is unusually hot, thereby securing better development of the fruit than if it were picked abnormally early. It also suggests the possibility of holding pears for longer consumption for a longer period if they are placed in a warm room rather than by making an effort to store them in slightly cooler temperatures.

The storage experiments indicate that different varieties of pears differ considerably in the stage of maturity at which they should be picked for market. The Bartlett pear is found to be greatly improved in quality if picked in the earlier stages of its maturity, as compared with certain other varieties. On the other hand, the Bosc has failed to reach good quality when ripened in storage unless it reached a higher stage of maturity on the tree than is required for the Bartlett. The Bosc variety picked when well matured on the tree and placed in storage, finally attained most excellent quality at ripening, while if picked too early it remained hard, broke down very quickly when the ripening stage was finally reached, and developed only very indifferent quality. Experiments with a number of other varieties indicate that the stage at which a given variety is picked, governs largely the perfection of quality which it will reach when finally ripened in storage.

Tests have been conducted to determine whether dried fruits are in danger of being injured by freezing under conditions of usual shipment to eastern markets. Commercially processed and packed fruits, which upon test were found to contain approximately 22% of moisture, were not frozen or injured when subjected to a temperature of 25° below zero F. This seems to remove any question as to their ability to withstand the low temperatures to which they might be subjected when en route to eastern markets in winter when shipped in ordinary freight cars.

Fruit Drying.—A survey of the state covering drying practices, was conducted by Sweet. Average results showed that eight pounds of sulfur per green ton of fruit is used in drying, the average exposure to the sulfur fumes varying from four hours to overnight. Five to five and one-half pounds of green fruit make one pound of dried fruit. After sulfuring, the fruit is exposed to the sun for two or three days, after which the trays are stacked for about the same length of time.

The Muir and Lovell are the best drying peaches, the Elberta coming third. Foster, Salway, Early Crawford, Late Crawford, Susquehanna, and Wheatland are also dried. On the average, the Muir and Lovell dry out five to one, Elberta seven to one, Foster and Susquehanna five and one-fourth to one, the others being intermediate between Muir and Elberta.

Hand picking the fruit from the trees, compared with shaking from the trees, gave 27% fancy grade and 22.75% extra fancy, as compared with 8.7% fancy and .7% extra fancy. Peaches are dried three and one-half days in the sun and about six days in the shade, that is, by stacking the trays.

One man can harvest 61 fifty-pound boxes per day by picking, or 87 boxes per day by shaking.

Drying practices with pears vary considerably. From fifteen to twenty pounds of sulfur per green ton is used. The fruit is exposed to the sulfur fumes from twelve to forty-eight hours, the minimum being in Contra Costa and the maximum in Lake County. The sulfur is burned in two or three charges. The sulfured fruit is exposed to the sun one to two days and then stacked for ten to twenty-eight days.

French and Sugar prunes dry out at about the rate of two and one-fourth to one, while the Imperial dries two and one-half to one. In the Santa Clara Valley in 1917 French prunes averaged 2.12 dry tons to the acre, Imperial 2 tons, and Sugar 3 tons. Prunes are dipped from an instant to one minute in a solution of 4.6 pounds lye to 100 gallons of water, which is heated to a temperature a little less than boiling. The prunes are then spread on trays and dried in the sun for about five days, then the trays are stacked for four and one-half to five days more. About 1 acre of dry-yard ground is necessary for every 20 acres of full-bearing prunes.

Tree Paints.—Various materials have been tested for covering pruning wounds on fruit trees. Cement paint seemed to stick longer and tighter than any other material. It was the most expensive paint tried. A hard asphaltum, one that would not run during hot weather, proved quite satisfactory in its sticking qualities, but was troublesome to apply, as it had to be painted on with a brush while warm. A roofing paint called Oronite served all purposes and was easy of application, as it was put on cold.

Root Stocks.—A test of root stocks for some of the common deciduous fruits was started in 1915. After four years, Royal Ann cherries on Mazzard and Mahaleb stock have made about the same growth. Bartlett pear on quince root has made very poor growth, while adjacent trees on French pear stock have made very satisfactory growth. Bartlett on Japanese pear root has done well for two years, and promises to be highly satisfactory. Bartlett top-worked on Surprise pear, which in turn was grafted on Japanese pear root, for the past two years, has made good unions. Prunes on almond and myrobolan stock so far have shown no differences in growth. Peaches and almonds on the different root stocks mentioned for stone fruits have shown no special differences in growth.

Large or Small Trees for Planting.—Hendrickson found that small nursery trees grow better than large ones. Perhaps the best size is a tree which measures from three-eighths to one-half an inch in diameter, a few inches from the ground.

Orchard Intercrops.—High-yielding crops of feterita, milo maize and Tepary beans were successfully grown between the tree rows in a two-year-old orchard where the trees stood 24 x 24 ft. apart on the square. There was no apparent injury to the trees, although no irrigation was practiced. Similar crops planted between the rows of various deciduous fruits where the trees were ten years old, failed to grow. Apparently there was too much shade, or the tree roots robbed the intercrops of needed moisture.

Spraying.—Crude oil emulsion sprayed on bearing trees of almond, Wickson and Burbank plums, German prune, Lovell, Sneed, Yellow St. John and Salway peaches, and Lewis, Smyrna and Routier's Peach apricots on January 11, 1919, did not cause serious injury to any of the trees or markedly influence the starting of growth or time of blooming. The bloom may have been slightly hastened on Drake and I.X.L. almonds. At the same time, there was an apparent retardation of bloom of Salway peach, Jordan almond, and Wickson plum. On May 22, the yield of the Yellow St. John and Salway peaches, as well as the Smyrna and Routier's Peach apricots seemed to be reduced by the oil spray. All the trees looked equally healthy.

Dry lime-sulfur for spraying dormant peach and apricot trees in fall and winter proved as effective as liqued lime-sulfur or Bordeaux mixture in protecting trees against leaf curl, twig blight and shot-hole fungus. Used as a summer spray after trees were in full leaf, dry lime-sulfur produced about the same effects on the foliage as the other two sprays.

Mulching Orchard Trees.—Newly planted trees of seven different species of deciduous fruits in 1917 were mulched with straw and barnyard manure, for the purpose of taking the place of tillage and irrigation. Moisture determinations were made from June until December each year. Results show no constant differences in moisture content between different mulch plots and those not mulched but given normal cultivation throughout the season.

Orchard Tillage.—Beginning in 1916, old fruit trees of various kinds were cultivated in different ways throughout the season. Ten plots of approximately one acre each ranged all the way from no cultivation to what is believed to be excessive cultivation. A summary of three years' results shows no constant differences in moisture content for the different plots with the single exception of the uncultivated block. During the dry season of 1918, the trees on this block suffered greatly from lack of moisture, a few of the trees dying.

Effect of Irrigation on Quality of Peaches.—During the summers of 1917 and 1918, extensive analyses of Muir peaches were made at different stages of ripeness to determine, if possible, the effect of irrigation on sugar content. No constant differences were found that could be attributed to the influence of watering the trees.

Spraying of Stone Fruits for Shot Hole and Twig Blight.—During 1916–17 an extensive coöperative experiment was carried out in the following counties:

San Joaquin, Yolo, Placer, Santa Clara, Alameda, San Benito, Sonoma, and Sutter, with the help of farm advisors, horticultural commissioners and growers. Results show that Shot-hole of almonds is controlled by the spring spray only, applied as the buds are swelling, being much more effective than the December spray which is most effective for peaches.

Apricots were sprayed fall and spring and after the fruit had set with the usual sulfur preparations and Bordeaux mixtures, but all were unsuccessful in controlling shot-hole. Thinning out the tops, however, reduced the disease to a considerable extent. Neither the dormant sprays nor the application after the fruit had set had any effect in the twig blight. As atomic sulfur and like materials showed a tendency to stunt the foliage, and Bordeaux and self-boiled lime sulfur leave a stain on the fruit at maturity from the application at fruit setting, the problem resolves itself into the finding of a suitable spray material for late applications.

Limb Gall of Apricot.—Studies on the aerial gall of apricot by Khazanoff under Horne, indicate the causal agent to be a new species of *Monchaetia,* a parasitic fungus. The galls are formed by a thickening of the bark, rather than by increase in the wood as in crown gall, and increase in size from year to year. The disease is quite prevalent in Alameda, Santa Clara, and San Benito counties on old Moorpark trees only, trees up to about fifteen years old seeming to be immune. The galls spread until the trees are practically destroyed and little clusters of affected trees are formed in the orchard. The pruning out of affected bark by the usual methods has been proved to be a sucessful means of control.

Oak Root Fungus.—Work on the Armillaria or oak root fungus disease of orchard trees in its more practical phases has been continued by Horne. So far as the injury caused by this disease is concerned the situation remains about as it has been; that is, there is a constant loss from trees killed in the orchards. The number of people who are undertaking measures for control is increasing slowly. All efforts during the recent war time have been devoted to studies and demonstrations in connection with the mapping and locating of trenches to stop the spread of the trouble. The judgment of practical growers seems to support our suggestions in connection with trenching much more than in earlier years.

Drying Fruits Without Sulfurous Acid.—It has been found by Cruess that the color of most fruits is satisfactorily retained if the fruits are cooked a short time (varying with the fruit from 3 to 30 minutes) in a 40% glucose solution before drying. Further work is under way on this project in coöperation with Overholser; the primary object being the determination of the chemical process by which sulfur fumes prevent bleaching. This knowledge is fundamental to the further study of the problem.

Salvaging Rain-Damaged Prunes.—As a result of field and laboratory investigations by Cruess and of a study of the literature after the disastrous rains of September, 1918, the sulfuring of rain-wet prunes for two hours to prevent molding or fermenting and the more universal building of evaporators as insurance against rain damage are recommended. (See Circulars 212 and 213.) By the simple process of sulfuring, millions of dollars worth of fruit could have been saved in 1918.

Sugaring of Dried Fruits.—S. Katzprowsky, a graduate student in Zymology, developed and patented a process of treating dried fruits with a dextrin solution to prevent sugaring. Sugaring is at present a serious problem of packing houses. Katzprowsky's process has consistently prevented sugaring in experimental tests.

Sterilizing Fruits at Low Temperatures.—Fruits in canning are usually heated to 212° F. This temperature injures the fresh-fruit flavor and texture. Experiments by Cruess have shown that many fruits may be sterilized at 165° to 175° F. with retention of the fresh-fruit flavor to a remarkable degree. Such fruits have been held for over three years, demonstrating their keeping qualities.

Fruit-Drying Investigations.—In the summer of 1918 a large number of varieties of peaches were tested as drying stock. The indications are that some of the white-fleshed varieties may prove to be a valuable acquisition to the list of those used for drying purposes. At the present time the markets handle only yellow-fleshed varieties. These tests will be continued, and apricot varieties will be added to the test. Work is being done by Overholser and Cruess on the effects of sulfuring on fruit tissues and its possible relation to the palatability of the dried product.

Tests made with Muir and a few other varieties to determine the effects of drying fully ripe peaches as compared with partially ripe peaches, were conducted during the summer of 1918. There was an 11% gain in weight of dried product where Muir peaches were allowed to become fully ripe, over similar fruit dried when partially green. These tests will be continued this year.

Spraying.—Dry limesulfur has been tested by the Division of Pomology in comparison with liquid lime-sulfur and with Bordeaux mixture as a dormant spray. It has also been compared with the other sprays by using it on peach trees in full leaf. Dry lime-sulfur in all cases proved to be just as effective as liquid mixtures in controlling disease, and was no more injurious to tender foliage than the others.

Crude oil emulsion applied to almond, peach, plum and apricot trees in winter in some cases seemed to cause slight injury to the buds, but did not materially influence the time of bloom. The greatest injury was to the Salway peach, Wickson plum, and to the Smyrna and Routier's Peach apricot.

Apricot Bacterial Gummosis.—A rather serious bacterial disease of apricot trees, has been under observation and study by Barrett since the spring of 1916. The causal relation of the bacterial organism associated with it has been definitely proved by inoculation. The symptoms of the disease are in the main the same as those of the bacterial gummosis disease of cherry found in Oregon, and there is now little doubt but that the cherry organism, *Pseudomonas cerasas* Griffin, also causes the disease of apricots. Its activity is largely confined to the dormant period and is soon checked by growth activities in the spring. Large areas of bark may be killed in a short time and due to complete girdling large branches and frequently entire trees are killed. Infection takes place in the fruit spurs, either buds or blossoms, and a serious blossom blight sometimes results. Identified in two widely separated sections in 1916, it now occurs in eight counties, including the best apricot sections of the state. Control measures which have given promising results have been confined almost entirely to surgical methods.

Crown Gall.—The testing of different species and varieties of prunes for crown-gall resistance by artificial inoculation by C. O. Smith, shows a great variation in their susceptibility. Thirty-five different species (native, European, and Asiatic) have been tested. The same variability may also show in the varieties of a species as in *P. domestica.* Fifteen different varieties of this species were in the experiment. Six of them show less than 20% infection. *P. cerasifera* is in general very susceptible. Certain of the native species while resistant have other unfavorable characteristics as stocks. Some of the Asiatic species show less than 20% infection. The more promising of these stocks will be tested out under different climatic and soil conditions to determine their value as stock for the different stone fruits.

Feeding Damaged Prunes to Hogs.—Jaffa reports that owing to the damage to the prune crop from rains in the early fall of 1918, a large tonnage of prunes was rendered unmarketable, and feeding trials with damaged prunes were therefore made by one of our large hog feeders, Mr. W. L. Bohanon, who kindly volunteered to coöperate with the college in the study.

Two pens of hogs were devoted to the experiment, each containing 30 pigs, averaging 60 pounds each. Pen No. 1 was fed garbage and prunes. Pen No. 2 was fed garbage only. The average weight of total feed per pig per day was 10 pounds.

After various trials with the feeding of prunes it was found that the 30 pigs would best utilize only 45 pounds per day, or 1½ pounds per animal. This amount was eaten up clean with the garbage and apparently relished by the animals. The experiment was started November 8, 1918, and accurate weighings were made at four stated periods as indicated below:

	Pen No. 1	Pen No. 2
Weight—	Garbage and Prunes lbs.	Garbage Only lbs.
Nov. 8	1845	1845
Nov. 13	1972	1922
Nov. 22	2280	2065
Dec. 2	2620	2262

No harmful results of any kind were noted. In other words, the moldy and otherwise damaged prunes did not cause digestive disturbances or injury to the health of the pigs consuming this fruit.

Chemical Analyses of Prunes.—At the request of the California Prune and Apricot Growers' Association, a number of samples of prunes from different localities were analyzed by the Nutrition Laboratory for preliminary work on the standardization of prunes.

The following tables show the results of the chemical analyses:

ANALYSES OF PRUNES

Table I

Lab. No.	2692	2693	2694	2695	2696	2697	2698
Composite	40/50	50/60	60/70	70/80	80/90	90/100	
	Nos. 1-2-7-8	Nos. 13-14-19-20	Nos.3-4-9-10	Nos. 11-12-15-16-21-22	Nos.5-6	Nos. 17-18-23-24	Nos.25 27-28-29-30
	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	Pr. Ct.	PCt.
Water	20.90	19.09	20.25	30.24	20.14	31.66	21.84
Total sugar	54.76	49.11	53.21	47.28	53.38	45.28	56.19
Total sugar calculated to 25% Water Basis	51.85	45.55	50.05	50.82	50.15	49.70	53.80

Table II

Lab. No. Designation of sample	2731 "A"	2750 "B" 13-15-17	2751 "C"	2752 "D"	2753 "E" 19-21-23	2754 "F" 25-27-29	2755 "G" 1-3-5
Water	19.29	14.61	17.16	15.90	15.37	14.40	16.00
Total Sugar	45.24	44.32	41.30	46.40	44.10	50.94	48.65
Total sugar calculated to 25% Water Basis	42.14	38.93	37.64	41.38	39.08	44.63	43.43

ANALYSES OF DRIED APRICOTS

Samples submitted by California Prune and Apricot Growers' Association.

Lab. No.	Designation of Sample.	Moisture	Total Sugar. Copper Test	No. of Pieces per lb.	Total Sugar. Calc. to 25% Moist.
2405	A—Fancy Hemet—processed at end of July, taken from a 25-lb. sample box that had been opened about 10 days	32.21	39.28	95	43.45
2439	B—Santa Clara extra choice—processed (Inderrieden, Herbert, Harlan, Pacific Fruit and Gem City)	31.65	44.08	100	48.39
2440	C—Winters extra choice—processed (Woodland apricots)	31.82	42.00	100	46.20
2441	D—Suisun extra choice—Processed	38.41	42.72	105	52.05
2442	E—Fresno extra choice—processed	28.49	45.12	112	47.31
2443	F—Ventura extra choice—processed	27.03	45.12	148	46.38
2444	G—Hemet extra choice — processed	33.61	40.00	140	45.20
2432	N—10—Fresno extra choice—natural	11.49	56.40	142	63.60
2433	N—11—Santa Clara extra choice —natural	22.66	53.84	126	55.85
2434	N—12—Winters extra choice—natural	16.86	49.75	120	44.75
2435	N—13—Suisun extra choice — natural	21.24	49.44	113	47.10
2436	N—14—Ventura extra choice—natural	24.33	52.48	180	52.05
2437	N—15—Hemet extra choice—natural	21.02	51.02	153	48.45
2438	N—20 — Unprocessed, ungraded Hollister cots taken from various growers' lots. This is good delivery as far as moisture goes.	35.73	49.40	72	57.62
	Average	26.90	47.19	122	48.42

Analyses of Foreign and Domestic Almonds

		Physical Analysis					Chemical Analysis					
		Weight			Per Cent							
Lab. No.	Name	50 Nuts Gms.	Kernels Gms.	Shells Gms.	Kernels	Shells	Water	Ash	Prot.	Fat	Fiber	Nitrogen-Free Extract
*2347	Sicily	......	48	......	......	......	5.57	3.34	21.18	54.47	2.77	12.67
*2348	3 Crown Bull Valencies	......	50	......	......	......	3.72	3.08	20.92	52.23	2.71	17.34
*2349	Medium Jordan	......	53	......	......	......	3.58	3.18	22.40	53.05	2.71	15.08
*2350	Large Alicante	......	57	......	......	......	3.82	3.00	21.88	54.53	2.33	14.44
*2351	Medium Avola..	......	56	......	......	......	3.42	2.93	20.57	59.42	1.95	11.71
2352	Nonpareil	104	69	35	66.4	33.6	4.20	3.36	23.54	54.14	2.02	12.74
2353	California Paper Shell....	106	74	32	69.9	30.1	6.55	3.48	24.07	52.30	2.57	11.03
2354	Princess	97	69	28	71.1	28.9	6.52	3.38	22.84	54.59	2.22	10.45
2355	Kings Soft Shell	95	70	25	73.6	26.4	9.79	3.01	22.37	55.81	2.51	6.51
2356	Ne Plus Ultra..	157	84	73	53.6	46.4	4.17	3.03	22.75	55.92	2.40	11.73
2357	I. X. L.	151	83	68	54.9	45.1	4.65	3.06	21.88	53.64	2.39	14.38
2358	Reams	147	61	86	41.1	58.6	5.50	3.52	20.22	56.62	2.63	11.51
2359	Drake	164	72	92	44.0	56.0	8.37	3.38	26.25	53.78	2.39	5.83
2360	Jordan	250	60	190	24.1	75.9	3.41	3.17	26.78	49.34	2.57	14.73
2361	Peerless	165	65	100	39.4	60.6	6.63	3.37	25.47	52.32	2.30	9.91
2362	Harriot	157	71	86	45.2	54.8	3.73	3.33	22.23	54.98	2.22	13.51
2363	Lewelling	172	80	92	46.6	53.4	7.50	3.35	24.33	51.92	2.28	10.62
2364	Languedoc	109	52	57	47.8	52.2	4 68	3.74	25.75	48.90	2.34	14.59
2365	Texas Prolific..	147	61	86	41.4	58.6	4.51	3.14	24.24	54.25	2.20	11.66
	Av. Domestic....	144	69	74	51.4	48.6	5.74	3.31	23.72	53.49	2.56	11.38

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* (Inclusive) Foreign.

* Only shelled nuts received.

2352–2365 (inclusive), domestic, submitted by Division of Pomology.

Composition of Dried Apricots.—In accordance with a request from the Californie Prune and Apricot Growers' Association fourteen samples of dried apricots were examined in the Nutrition Laboratory with a view of initiating an investigation which would have for its object the standardization of dried apricots.

The accompanying table presents the results of the chemical studies of the samples from several different localities. The water percentage varies from 11.5 as a minimum to 38.4 as a maximum, the average being 26.9.

The sugar content, as was to have been expected, ranged inversely with the moisture percentage, the average being 47.19. The results reported are not sufficient to warrant an attempt at standardization at this time.

Composition of Foreign and Domestic Almonds.—The Nutrition Division cooperating with that of Pomology made complete chemical examinations of fourteen different varieties of domestic almonds grown at Davis and, for the sake of comparison, five varieties of imported nuts.

The following table contains the analytical data for these nuts. The imported varieties were received in the shelled form and, therefore, no figures are given for refuse, or shells.

The data presented are interesting in showing that the domestic almonds are equal in nutritive value to the imported article. The protein content of the former is higher on the average than that indicated for the latter, while the average for the nitrogen-free extract is correspondingly lower.

GRAPES AND OLIVES

Uses for Wine Grapes.—The sun-drying of wine grapes was found by Bioletti and Way to be practicable in the warmer raisin districts by the methods used for the Muscat. The yield for three years with eleven varieties has averaged 625 pounds from one ton of fresh grapes at 25% Balling. This is a little higher than the yield of Muscat.

Red grapes, dried in an evaporator, preserve their color better and are more suitable than sun-dried grapes for wine making. Most of the wine grapes are grown where sun drying is impossible. The various evaporators in use have been studied, and plans and specifications have been prepared for one to cost about $1200 which will hold six tons of grapes at a charge.

Various other means of utilizing wine grapes have been investigated and the results published by the coöperation of the State Viticultural Commission. None of them promises complete relief to the growers of wine grapes.

The Currant Grape.—The Black Corinth or true currant grape, according to Bioletti, Flossfeder and Way, has been a failure on its own roots at Davis. No method of pruning tested has given good results. At Kearney it has done better, but the crops are irregular. When grafted on resistant stocks, the returns have been a little better at Davis and promising at Kearney. The best stock at Davis has been the *Riparia gloire* on which it has yielded above 1.75 tons of dried fruit per acre. At Kearney the best stock has been *Chasselas Berlandieri* 41-B, on which it has yielded about 2 tons. Increase of bearing by girdling is being tested, and has given very promising results. (See Bulletin 298.)

New and Rare Varieties of Grapes.—Among the promising table grapes during the last three years are the Kurtelaska, a grape of Malaga type, and the Marvel of Malaga, a grape somewhat resembling the Tokay. Bioletti and his associates state that the latter is especially promising for districts and soils where the Tokay fails to color well.

Much interest has been shown in the Ohanez or grape of Almeria. A discussion of this variety and of methods of growing it has been published in cooperation with the State Board of Viticultural Commissioners.

Other interesting grapes are the Madeleines, white grapes, and the Duc de Magenta, a red grape, all of excellent quality, and considerably earlier than the Chasselas or any of the grapes usually grown.

Phylloxera-Resistant Stocks.—A large amount of data has been accumulated by Bioletti and his associates on the complex question of the relative value of various stocks. One of the most remarkable results of the experiment work is the indication that the Rupestris St. George, which is used almost exclusively in California, is inferior in value to nearly all of the other stocks tested. Its only superiority seems to be in nursery work, and even here it has defects.

The stocks which have given the best results generally are: Chasselas X Berlandieri 41–B, Berlandieri X Riparia 420–A, Riparia X Rupestris 3306, and Riparia X Rupestris 3309.

On the basis of the results at Davis and Kearney, the following recommendations can be made regarding suitable stocks for our principal varieties of table, raisin, and wine grapes:

	Stocks		
Variety	1st Choice	2d Choice	3d Choice
Cornichon	3309	3306	41–B
Dattier	93–5	41–B	A X R No. 1
Emperor	3306	A X R No. 1	3309
Malaga	41–B	420–A	3309
Tokay	420–A	3309	41–B
Black Corinth	41–B	3306	Rip. gloire
White Corinth	3306		
Muscat	41–B	420–A	A X R No. 1
Sultana	A X R No. 1	41–B	420–A
Sultanina	3306	101–14	420–A
Palomino	420–A	3309	3306
Semillon	3309	420–A	3306
Alicante Bouschet	1202	420–A	41–B
Lagrain	41–B		
Gros Mansenc	41–B	1202	3309
Petite Sirah	3306	41–B	420–A
St. Macaire	420–A	3306	
Valdepeñas	420–A	41–B	

NOTE.—The numbers given in this table are the common designations known by nurserymen for these stocks and are the designations given by their foreign producers.

Vine Pruning.—Many pruning experiments have been made by Bioletti and his associates, confirming in most cases the recommendations of the vine-pruning publications of the station. It has been shown that long pruning of naturally fruitful varieties may increase the crop for a time, but that the consequent weakening of the vines results in smaller crops later which more than counteract any gains.

With Sultanina vines, little or no difference has been found between the fruitfulness of canes originating in old wood and those coming from last year's spurs. This is contrary to the belief of most grape growers and of writers on vine pruning. It may not apply to other varieties.

The cordon system of pruning has been tested and promises to be very suitable for Emperor, Cornichon, Ohanez, and perhaps other vigorous table grapes growing in rich soil. The system is described in a bulletin published in coöperation with the State Board of Viticultural Commissioners.

Summer Pruning of Vines.—It has been shown by Bioletti that all forms of removal of shoots or leaves in the growing season are weakening to the vine. Moderate pinching of the extreme ends of the shoots may increase the crop slightly but at the expense of sugar and quality. Repeated pinchings and toppings of all kinds were weakening to the vine and resulted in loss of crop in proportion to the severity of the pruning. Three toppings reduced the vigor of Carignane vines 31% in 1916 and 69% in 1917, and of Tokay vines, 38% in 1916 and 71% in 1917. The same treatments reduced the crop of the former 30% and 50% and the latter 23% and 39%. The sugar content of Carignane was reduced 20%. Pinching increased the second crop slightly, but severe topping decreased it. The losses from summer pruning varied from $3.53 per acre for a single pinching of the Tokay to $219.70 for three toppings of Carignane. (See Bulletin 296.)

Standardization of Shipping Grapes.—Examination and analyses of many hundreds of samples of shipping grapes in the market and in packing houses, Bioletti reports, indicate that the legal standard of 17% Balling is as fair as any that could be adopted and would prevent the shipping of unripe grapes if rigidly enforced.

The bearing of the effect of mildew or oidium on the shipping qualities of grapes was investigated by Flossfeder and it was found impossible to cause mildew to increase or grow on packed ripe grapes under any conditions of temperature and moisture. What is usually called mildew in this regard consists simply of the ordinary penicillium or similar molds. There seems, therefore, no reason to condemn grapes showing signs of mildew unless the mildew has already done sufficient harm on the vines to render the grapes unsuitable for shipment.

Investigations bearing on this subject have been published in the University of California Publications in Agricultural Sciences, Volume 3, Number 6, pages 103–130.

Sulfuring as an Insurance against Rain Damage of Raisins.—Experiments by Bioletti and Way showed that it is possible to save raisins by the use of a sulfuring hood, even in such rainy seasons as that of 1918. A simple hood was devised which was used with success for three years at the Kearney Experiment Vineyard. The cost is little more than that of ordinary stacking and, in fact, would probably be less, as it makes it possible to avoid unnecessary stacking for threatening rain. (See Circular 211.)

Grape Juice.—Much information has been acquired by Cruess regarding the means of producing an acceptable grape juice, by investigations extending over two seasons at Davis. The most satisfactory juices are clear and of full grape flavor. The public taste usually prefers a red color and a considerable acidity or tartness. Such juices were made by combining slightly under-ripe red wine grapes with ripe Muscat or highly flavored wine grapes, such as

Semillon or Riesling. By the methods developed and proper advertising it would seem feasible to increase considerably the output of grape juice in California.

Grape Syrup.—As a result of two year's investigation by Bioletti and Cruess a syrup of fresh grape flavor and of either deep red or white color has been made by a combination of the freezing and the vacuum evaporation processes. This syrup is excellent for table use, water ices, ice cream, and for a beverage when diluted with carbonated water. It may be made from wine grapes or sound second crop and cull table or raisin grapes. This syrup has also been shown to be suitable for wine making.

Pruning Olive Trees.—Observations in many orchards indicated that the usual methods of pruning were defective, resulting in slow development of the young trees and excessive height and irregular bearing in the old trees.

A method based on these observations and on experimental work has been devised by Bioletti and Flossfeder which seems better than any at present in use. It consists essentially in limiting the pruning of young trees to the minimum necessary to give them the proper form of framework and of the old trees to an annual thinning out of small branches and twigs. In all cases thinning out is emphasized rather than cutting back.

The method was described in a short article in several county farm bureau journals and in a longer article in The Fig and Olive Journal.

Control of Color of Ripe Olives.—The darkest and best color of ripe olives, according to Cruess and Zion, is obtained when the lye used does not exceed 3% or fall below 1% and when the first treatment (before air exposure) barely penetrates the skin. Exposure after the second lye treatment does not increase the color. Among minor influences, it was found that the higher the temperature during exposure the deeper the color, though rapid shrivelling occurs above 90° F. Slight alkalinity of the brine in the cans (not over .01%) increases the color, while acidity bleaches. High temperature of sterilization increases color.

The use of enamelled cans was found very favorable to the stability of the color. Plain tin injures the color and clouds the brine.

New Process of Olive Pickling.—The time required for pickling ripe olives is usually at least fifteen days. By a new process devised by Cruess based on the use of heated, aerated, and circulating liquids, the operation requires only three to four days. This process has been successfully used in large factories for two seasons. It is protected by Public Service Patent 1,257,584, granted on February, 1918, to W. V. Cruess, and can therefore be used by anyone without payment of royalty.

Ripe olives after pickling were allowed to undergo a lactic acid fermentation in 7% brine in a closed barrel. The flavor developed was excellent and different from that of the usual ripe or green olives. The product would probably be successful commercially. (See Bulletin 289.)

Refining Inferior Olive Oil.—Cruess, in coöperation with C. C. Scalione has developed a process by which the disagreeable odors and flavors of inferior olive oil can be removed. The oil is treated at 185° F. to 190° F. with about .1% soda ash, 2% to 5% fine bone-black, and a stream of carbon dioxide. After cooling and filtering the oil is stored. Twenty-five thousand gallons of oil was treated in this way with excellent results.

Oil in Olive Pomace.—In coöperation with A. W. Christie, it was shown that olive pomace contains from 6 to 14 per cent of oil recoverable by means of solvents. From 16 to 38 gallons can be recovered from a ton of pomace by means of gasoline. This oil is worth from $10 to $20 for soap making.

High Alcohol Production by Fermentation.—It as found by Cruess and Brown that by gradual slow addition of grape syrup to fermenting must, very high percentages of alcohol could be formed. A pure wine yeast in this way was made to produce from 17% to 22% of alcohol. Placed directly in a must containing 33% to 35% of sugar, this yeast formed less than 16% of alcohol.

WALNUTS

Die-Back or Winter-Killing of Walnuts.—This injury to walnut trees is very common in the inland sections where the annual damage to young groves is especially serious. The work of Batchelor and Reed indicates that die-back injury may prevail with, or without, extremes in temperature. This injury should be considered as the final result of one or several conditions which are adverse to the normal growth of the tree, the ultimate effect of which is to kill the tender twig growth by desiccation. Such conditions usually occur during the winter and are made operative by being preceded by one or more of the following causes:

(*a*) Early fall frosts may injure the foliage and cause it to drop prematurely and thus expose the immature twigs to excessive transpiration in the late fall and winter.

(*b*) During winter a drought, if irrigation during the dormant period is lacking, the usual moisture lost can not be made up for by the twigs of normal well-matured trees, thus desiccation and winter injury occurs. Mature bearing groves are frequently subject to this injury; many were damaged during the winter of 1917–18. A medium heavy irrigation soon after harvest season, in November or December, is a safeguard against this injury when caused by winter drought. With lack of anything but speculative knowledge concerning the probable occurrence and volume of winter rains, and the established fact that frequently such rains are too late in occurrence and insufficient in amount for the best welfare of walnut groves, the regular practice of fall irrigations may be considered insurance against this type of winter-injury.

(*c*) A sudden fluctuating high water table injuring the root system of the trees acts as a severe root-pruning which is followed by a lack of moisture in the twigs and thus the die-back injury.

(*d*) A high water table acting as continual subirrigation produces a tender, succulent fall growth of young trees susceptible to fall frost injury followed by die-back mentioned under (*a*).

(*e*) Walnut trees growing upon soil with a high alkali content are often seen to leaf out and blossom in September and October following a premature dropping of the first crop of leaves. This late fall growth is injured by frost and followed by the death of the tender twigs the succeeding winter.

Apparently the so-called winter-injury or die-back is seldom due primarily to a low winter temperature, but rather to an abnormal maturity of the twig growth in relation to the usual growing season or else to unfavorable soil moisture conditions.

A New Walnut Variety.—In the course of the study of the walnut varieties and seedling trees in their relationship to resistance to walnut blight and general practical value, a new variety has been introduced to the public for commercial trial. This very meritorious walnut was found by Batchelor, growing in obscurity near Santa Ana, during the spring of 1915. A group of 38, eight-year-old grafted trees of this selection, as yet unnamed, and never introduced into the trade, were making a remarkable showing in freedom from blight, and in precocity and heavy production. A knowledge of the original parent tree had been lost with the death of the propagator of the trees in question, and the present owner was not inclined to interest himself in the dissemination of this worthy selection. During four years' observation of these trees by members of the experiment station they have proved to be remarkably prolific, and only slightly affected with walnut blight, yet productive of nuts which fulfill the commercial demands of the trade; the variety has, therefore, been named Ehrhardt, after the owner of the trees, and recommended for commercial trial throughout the coastal sections of Southern California. At present the demand for trees of the Ehrhardt strain is far in excess of the supply.

Fungus—Enemy of the Walnut Aphis.—A new species of fungus *(Entomophthora chromaphidis* n. sp.) was found by Burger and Swain in 1917 to be a factor in controlling the walnut aphis in southern California. The groves in the spring of 1917 were heavily infested by the aphis and although the period of extreme heat of June and numerous insect enemies were responsible for the death of a large percentage of these aphids, the fungus contributed to their mortality. Observations made in El Monte before the hot period showed that 88 per cent of the aphids were thus killed. Some time after this period of extreme heat, the aphids increased rapidly but under the conditions noted were effectively controlled by this fungus.

Walnut Blight.—A study of the relative resistance of the young nuts of various commercial varieties to walnut blight by C. O. Smith has shown that those observed to be more resistant in nature were the more resistant to artificial inoculations. Certain of the more resistant, under natural conditions, showed at least five times higher percentage of blight when artificially inoculated.

Experiments to determine at what stage the new leaf growth of the walnut receives its initial infection showed that the dormant buds can not be artificially inoculated, but as they are opening they are more susceptible and become readily infected, particularly as the leaflets unfold.

From laboratory experiments to determine what relation the soil has to walnut-blight infection, it has been demonstrated that the blight organism can live for some time in sterilized soil (at least two and one-half months), while in the same soil, unsterilized, organisms die out in a few days (ten days being about the maximum time). This is probably because of the competition with soil organisms.

Walnut-Blight Control.—Experiments in pruning out all "hold over" cankers and other possible sources of infectious materials from walnut trees were carried on in Orange and Ventura counties in 1916 by Fawcett and Batchelor. Some of the pruned and unpruned plots were sprayed with Bordeaux mixture and lime sulfur solution, respectively. Others were unsprayed. Careful inspections and counts of infected nuts during the summer showed that the treated plots developed, on the whole, practically as much blight as the untreated. These results agreed in the main with those formerly obtained in spraying experiments for blight control.

Dusting for the Walnut Aphis.—The essential idea in making the material for this purpose, reports R. E. Smith, consists in impregnating a solid material or carrier with a solution of nicotine, followed by the necessary drying and pulverizing. As a source of nicotine the commercial preparation called Black Leaf 40 is used. This is a concentrated solution of Nicotine Sulfate containing 40% of nicotine. The basis of the carrier is formed by a kind of kaolin or clay obtained from Ione, California. In the original method the nicotine solution was diluted with considerable water, mixed with the desired proportion of kaolin into a stiff mud and then dried in air or with a little heat and repulverized, several days at least being required to complete the process. This was too slow when the walnut growers suddenly demanded several hundred tons of material from a small, experimental plant. At present the following method is used: A mixture of 75% kaolin and 25% hydrated lime is made in a mechanical mixer, and while these materials are mixing the desired amount of Black Leaf 40 is blown into the mass in a fine spray, without any dilution. The lime dries out the moisture and also has a chemical effect, freeing the nicotine from the sulfate and rendering it much more active and effective, though less permanent, nicotine being more volatile than its sulfate. After this the material goes through other machinery which further mixes and pulverizes it, delivering the finished product into sacks. Twelve minutes are required to complete the whole process for each four-hundred-pound charge of material.

For the walnut aphis a mixture containing about 2½% of Black Leaf 40 (1% nicotine) is being used. Much greater strengths can be made and other materials such as sulfate, lead arsenate and copper sulfate may be added.

The dust is applied to the trees with large, power-driven blowing machines made for the purpose. Treatment for the walnut aphis is made whenever the insect commences to become abundant, using from one to four pounds of material per tree, according to size. Two men with a team and blower can thoroughly dust from two to four acres per hour. The total cost is from three to five dollars per acre. When applied with reasonable thoroughness this treatment almost completely wipes out the walnut aphis from an orchard. Thus far it has not been necesary to treat an orchard more than once during the season. More than five thousand acres have been dusted.

FARM CROPS

Summer Fallow.—The proper making of a summer fallow is one of the important processes in the production of larger crops of grain. It has been found by Gilmore and Mackie that a summer fallow properly made accomplishes three ends: It conserves moisture through the prevention of weed growth and improvement of the physical condition of the soil. It renders nitrates available, and it prepares the land for planting at the proper time. Perhaps the last is the most important object accomplished. To produce these three objects the fallow should be properly cultivated to the end that a good surface mulch be secured, the weeds killed, and the moisture be conserved and evenly distributed through at least six feet of soil. Preliminary studies have shown that a properly cultivated fallow contains at the close of the season about three times as much soluble nitrogen in the upper two feet as an uncultivated fallow or one growing weeds. This advantage has been well illustrated in a series of field plots at the University Farm, where 44 bushels of wheat and 76 bushels of barley per acre have been produced during the somewhat unfavorable season of 1919.

Continuous Cropping to Grain is Detrimental.—Investigations still in progress corroborate and emphasize the results gained in previous years, that continuous cropping will lead to unprofitable yields. Gilmore reports that the yield of wheat plots at Davis continually cropped has gradually declined during a series of years, the rate of decline varying somewhat acording to seasonal rainfall. Thus in a series of trials just concluded the yield of wheat on plots continuously cropped for five years declined from 48.2 bushels per acre to 11 bushels per acre. Possibly this rapid decline has been influenced to some extent by unfavorable seasons, but the results of general observation leave no doubt that rotations, green manuring, clean summer fallow, and the diversification of crops, on the same land are essential to the maintenance of the crop-producing power of our non-irrigated lands.

Since the major portion of the improved land of California is cropped under a deficiency of rainfall, the importance of maintaining an optimum organic matter content and suitable moisture relations is strongly emphasized.

In contrast to the figures above it should be noted that the average yields of three plots alternately in wheat and fallow were as follows, for the years 1914–16–18, respectively: 15.8 bushels, per acre, 48.44 bushels per acre, and 44.61 bushels per acre. It is believed, however, that alternate grain and fallow will not indefinitely maintain good yields, but that a cover crop will have to be grown occasionally in order to maintain the organic matter content of the soil.

Grain after Legumes Turned Under.—Gilmore and Madson report that the importance of maintaining a favorable amount of organic matter in the soil is emphasized by the following results for several plots in the rotation experiment:

Plot	1914	1915	1916	1917	1918
538	Wheat 30 bu.	Peas	Wheat 44.67 bu.	Peas	Wheat 52.33 bu.
539 check	Wheat 35 bu.	Wheat 15 bu.	Wheat 21.67 bu.	Wheat 30.60	Wheat 25.5 bu.
540	Peas	Wheat 18.60	Peas	Wheat 39.33	Peas
541	Wheat 24 bu.	Vetch	Wheat 54.33 bu.	Vetch	Wheat 51.66 bu.
542 check	Wheat 22 bu.	Wheat 12.16	Wheat 29.55	Wheat 27.33	Wheat 25.5 bu.
543	Vetch	Wheat 15.92	Vetch	Wheat 36 bu.	Vetch

These figures represent yields for alternate years, but considering that the seasons, except 1915, have been unfavorable for high yields the records are significant as bearing both upon the influence of legumes on yield, as well as upon the maintenance of yields through adverse seasons. These figures should be compared as to annual yields rather than the total yields through the entire period. Other long continued experiments show that continuous cropping to grain results in unprofitable yields and the processes of restoring such yields are long and expensive. The amount of dry matter in the legumes plowed under was about 1000 pounds per acre.

Fertilizers on Grain.—For two years past fertilizers have been applied to fields of grain in several parts of the state where conditions indicated the necessity for such treatment. Preliminary studies by Lipman of positions of these fields where the grain was good, indicated that the principal difference between the soil under the poor grain and that under the good grain was a plentiful supply of available nitrogen under the latter. In view of this fact nitrogenous and other fertilizers were applied by Gilmore in plots for comparison. At Stockton the results on wheat may be summarized in the following average yields of grain per acre during two years:

Plot 6—50 lbs. Nitrogen from Sulphate of Ammonia	1052 lbs. per A.
Plot 7—Check. No treatment	617 lbs. per A.
Plot 9—50 lbs. From Nitrate of Soda	864 lbs. per A.
Plot 19—Check. No treatment	673 lbs. per A.
Plot 20—Complete fertilizer with lime	904 lbs. per A.
Plot 24—Potash and Phosphorus with organic matter	907 lbs. per A.
Plot 25—Check. No treatment	630 lbs. per A.

A very low rainfall last year caused the average of the two years to fall lower than normal, nevertheless there is a decided advantage shown by the use of both sulphate of ammonia and nitrate of soda.

The results at Glendale for 1918 are even more striking in relative yields, though because of the dry season the total yields are small. They are as follows:

No treatment	278.6 lbs. per A.	
Residual (150 lbs. in '17)	495.8 lbs. per A.	
Sulfate of Ammonia	150 lbs. per A.	546.9
Sulfate of Ammonia	200 lbs. per A.	658.9

Cereal Diseases.—Since 1917 a campaign to reduce smuts in cereals has been conducted coöperatively between the Office of Cereal Investigations of the U. S. Department of Agriculture and the College of Agriculture. Mackie reports that practically all the grain farmers were reached through meetings, demonstrations, or personal visits to the farms in efforts to introduce measures for smut control. A survey in 1918 following the fall campaign of 1917 showed some progress in reduction of smut, but the greatest reduction followed the campaign of the fall of 1918. The survey of 1919 shows that the ravages of smut in wheat and barley have been reduced to a minimum, with whole areas practically free from smut.

A New Barley for California.—Madson and Hendry report that 9 years of variety tests at the University Farm have demonstrated the superiority of Mariout barley over Coast (common) barley. During this period Mariout has average 88.0 bu. per acre, as compared with 80.68 bu. for Coast. In drought years Mariout has produced far in excess of Coast. In 1919 with deficient spring rainfall Mariout yielded 79.0 bu. per acre compared with 38.0 bu. per acre for Coast. In spring planting tests Mariout has had a greater advantage over Coast than in fall planting tests. Mariout shatters less than Coast when exposed to strong winds at maturity. In 1919, the yield of Mariout was diminished 12 per cent through shattering, compared to 46 per cent for Coast. Mariout makes a lighter draft on soil moisture than Coast barley. Determinations at the University Farm in 1919 showed that Coast barley had consumed 45 per cent of the soil moisture to a depth of 3 feet compared to 26 per cent for Mariout. Mariout ripens 10 to 20 days earlier than Coast barley.

Irrigation of Grain (Barley).—Eight years' investigation at the University Farm as reported by Beckett shows the following results:

Season	Aver. Rainfall Inches	No. of Irrigations	Aver Dept of Water Applied Ac. in. per A.	Aver. Yield of Grain lbs. per A.	Cost of Irrigation per Acre
Dry Years—Less than 15 inches rainfall.					
1910, 1912	....	None	......	676	......
1913, 1918	9.91	One	7.5	1724	2.25
	....	Two	12.5	2115	3.65
Wet Years—Over 15 inches rainfall.					
1911, 1914	....	None	......	1601	......
1915, 1916	23.20	One	5.4	2035	1.94
		Two	7.0	1810	2.88

The figures indicate that in years of deficient rainfall the application of irrigation water produced a material increase in yields, up to a total of 22 acre inches of rainfall plus irrigation water.

In years of heavy rainfall the application of irrigation water produced no definite increases. A study of the results obtained in each of these wet years shows that where the rainfall is normally distributed the increase in yield is not sufficient to warrant the application of irrigation water.

Rotation and Double Cropping of Field Crops Under Irrigation.—During the first four years of an eight-year experiment reported by Beckett, a rotation of grain, sugar beets, Indian corn, and potatoes was tried in various combinations under varying irrigation treatment. A comparison of maximum yields during this period failed to show any one rotation of these crops as being preferable. During the last four years the area has been cropped exclusively to grain and beans, a double crop of grain followed by beans, being planted in 1918.

During the first four years of this rotation, barley was seeded in 1912, 1914 and 1915 and produced an average maximum yield of 2280 lbs. per acre, while wheat seeded in 1913 produced 1800 lbs. per acre. The average grain yield for the four years was 2160 lbs. per acre. The fifth year a yield of 1460 lbs. of barley was obtained, while the seventh year's grain crop yielded 1086 lbs. of barley per acre. Wheat planted on this area in 1919 resulted in a crop failure. Indications are that this decrease in yield is due primarily to the increasingly poor physical condition of the soil resulting from continuous irrigation without the addition of organic matter.

During 1917 and 1918, the maximum yield of Mexican Red beans under favorable irrigation treatment decreased from 1440 to 935 lbs. per acre.

Grain Sorghums.—Grain and forage sorghums, according to Madson and Hendry, continue to be one of the most important forage and grain crops for the state. Investigation, however, has shown that the yields produced under optimum conditions are about four times the average. This wide discrepancy is due in part to adverse conditions of weather and soil that cannot be overcome, but the larger factors are in the preparation of the land, the time of planting to secure a good stand, and in the use of pure, good seed of the proper variety.

The problem of securing pure, good seed has received special attention; it is suggested that each farmer growing this crop can select his own seed to much greater advantage than to depend upon buying it. It requires only the seed of from twelve to fifteen heads to plant an acre. Hence, by going through the field before harvesting the crop and selecting superior heads for seed, the farmer is earning his best income. This seed may be threshed and by placing it in water, the light and unproductive seed may be separated from the heavy and viable seed. By this method of seed selection, yields of from 2500 to 5000 pounds per acre have been produced, as contrasted with less than half those yields by ordinary methods.

Sudan Grass.—Madson and Kennedy report that Sudan grass is a crop that has become well established in California during recent years and is one of the most valuable and productive forage plants that can be grown under conditions where alfalfa is not possible. Its resistance to unfavorable moisture conditions is a striking and valuable quality. On plots at the University Farm which had been previously cropped to cereals this grass produced 3554 pounds of hay per acre when the total rainfall amounted to only 8.84 inches. During years of normal rainfall it has produced as much as 5 tons per acre. When moisture is deficient the crop responds to irrigation, producing under such conditions from 5 to 6 tons of cured hay per acre. The crop is therefore highly recommended as a forage crop under soil and moisture conditions where alfalfa cannot be grown.

Grain and Hay Fires.—As part of the state-wide fire-protection campaign an investigation was made by Metcalf of the causes of grain and hay fires from 1915 to 1917 and for 1918. It was found that harvesting machinery caused the greatest number of fires, these resulting mainly from defective spark arresters. Preventive measures were suggested to tractor manufacturers and grain growers. In coöperation with other agencies especially the United States Forest Service, a plan of county organization for fire protection was worked out. This plan was put into effect in a majority of the farm bureau counties and reduction in the size of the average grain and hay fire resulted from 111 acres to 36 acres, and in the average damage per fire from $1384 to $931.

Alkali Tolerance of Beans.—One of the limiting factors to bean production throughout regions otherwise adaptable is the prevalence of alkali in the soil. Some studies have been made by Hendry, both in the greenhouse and the field, on the subject of alkali tolerance of this crop. No definie figures can be given, for the alkali tolerance of any crop depends on the amount and balance of each alkali ingredient, soil type, and other variable factors. However, both the data secured and general observation would indicate that the following grouping of varieties in respect to relative tolerance is correct:

Most tolerant: Blackeye, Horse bean, Garbanzo.

Moderately tolerant: Lima, Tepary.

Least tolerant: Small white, Red Kidney, Large white, Pink, Red Mexican, Bayo.

Beans an Important Crop in California.—Hendry reports that during the past three years beans have been given prominent consideration, both as a food crop and a crop admirably adapted to various systems of farming. California has passed during this period from third place to first among the bean-producing states in acreage production and value of crop.

Bean culture is noticeably influenced by climatic and soil conditions, and since California possesses wide variations in these factors it is essential to give close study to the several varieties of beans as related to their adaptation. This enables the state to produce successfully a larger list of varieties than any other state.

Considerable study has been given to the adaptation of varieties to different portions of the state. The following tabulation gives the economic distribution of acreage by percentage among the several leading varieties for the larger mean areas of the state:

	Bayo	Cranberry	Red Kidney	Large White	Pink	Red Mexican	Blackeye	Tepary	Small White	Lima	All Others
Northern counties	10	2.5	1	70	15	1.5	......	......	......	....	
Sacramento Valley	12	2.2	4	22.4	34	5	13	3	......	....	4.4
San Joaquin Valley	.1	....	.4	4.5	33	10.9	30.1	21	......	....	....
Central Coast	......	....	.3	5	9	2	25	42.3	......	....	17
Southern counties	......	....	....	4	8	.6	19	9	22.5	36	1

This table is instructive to the one who may be in doubt as to the variety most extensively planted in any region.

Composition of California Bean Varieties.—The Nutrition Division has examined and reported upon 16 samples of beans and the corresponding straw and pods. The complete analyses and comments thereon were published in Bulletin No. 294. With the exception of the French White showing 26.3 per cent protein, the Spotted Red Mexican with 22.2 per cent, and the Bayo with 22.6, the protein content in general is low as compared with the analyses of beans reported by different authorities. The data for the other nutrients compared favorably with the figures quoted for varieties raised elsewhere. The bean straw is richer in protein than are the cereal straws, the protein content for the Tepary Bean straw being 9.9 per cent. Seven varieties yield upwards of 6 per cent of protein, while the average is 5.7 per cent. The percentage indicated for the protein of the pods was low, with the exception of the varieties French White and Blue Pod showing 7.4 and 5.9 per cent, respectively, the average being 4.3 per cent.

The Irrigation of Cotton.—According to the investigations of Gilmore and Wilkinson the irrigation of cotton is one of the most important operations in producing this crop in the Imperial Valley. The procedure and amount of water varies with the type and condition of the soil. The investigations cover the two important questions as to time and amount of application of water. The results at this time indicate that when the soil is supplied with an optimum amount of water at planting, further irrigation should be withheld until the plants begin to form squares. If water is applied before this time the plants tend to vegetate and a bulky growth rather than the setting of bolls is the result. After squares are set the soil should be kept moist with a constant and uniform supply of water. To do this the amount and time of application will depend upon soil conditions, but irrigation followed by cultivation should occur at intervals of from two to three weeks. About four acre inches at each application on medium soil give best results.

Cotton Production.—In both the Sacramento and the San Joaquin Valleys cotton production, according to Gilmore, is on the increase, and the present outlook for this crop becoming permanent is good. The principal interest in this crop in the Sacramento Valley centers in its suitability as a rotation crop with rice and for this purpose it has proved successful on a number of areas.

Results obtained at the Kearney Ranch near Fresno have shown that both the short staple, or upland type, and the long staple, or Egyptian type, can be grown successfully. The yields secured may be summarized as follows in pounds of seed cotton per acre.

	1916	1917	1918
Durango (Upland)	2405	2010	....
Yuma (Egyptian)	1563	1615	2058
Pima (Egyptian)	....	....	2230

The percentage of lint has varied from 28 to 32, but is becoming constant towards the higher figure as the varieties become acclimated and are improved by selection. The lint of both of these cottons has been of high grade in both length and fineness.

From these figures it is evident that profitable yields can be obtained, but since experience has shown that growing both types of cotton in the same community is detrimental to both in yield and quality, the experiment station has laid emphasis on the use of the Egyptian type only, and is advising that only the Pima variety be grown throughout the San Joaquin Valley. To further this end the station is attempting to keep on hand for distribution pure, good seed of this variety.

Irrigation of Alfalfa in the Imperial Valley.—An extensive study of the prevalence of alfalfa roots in different types of soil has been made in order to determine the effect of irrigation on these roots. Packard and Wilkinson report that for the various types of soil it was found that feeding roots developed most abundantly where moisture was most constant and where no free water prevailed. Thus it was found that in sandy loam soils where water was applied frequently and in small amounts, 54.82% of the roots were in the first foot. Where an optimum amount of water was applied at frequent intervals the percentage of roots for each foot from the first to the sixth was as follows: First, 9.51%; second, 18.10%; third, 14.15%; fourth, 16.74%; fifth, 12.48%; sixth, 8.92%, making a total of 79.90% in the upper six feet of soil.

This wider distribution of water gave a larger zone in which the roots may feed and hence much better and more uniform yields result. In soils where a water table within four and a half feet of the surface was prevalent, 70.43% of the roots were in the upper two feet of the soil. Under such conditions the yields are small and the stand short-lived.

In general it is necessary to irrigate alfalfa according to the type and porosity of the soil, giving special attention to getting deep and uniform penetration of water and avoiding an excessive amount which would form a high water table.

Labor Required to Harvest Alfalfa.—An investigation by Davidson in cooperation with the Division of Farm Practice (Mr. Tavernetti), was made to determine the saving of labor which might be secured through the use of the side-delivery rake and hay loader in the harvesting of alfalfa. During the first crop for the season of 1918, it was shown on the University Farm that the labor expenditure in harvesting a ton of alfalfa could be reduced from 6.8 to 5 hours per ton. This work will be continued.

Harding Grass (Phalaris stenoptera).—Experiments by Kennedy at the University Farm have proved that Harding Grass will maintain itself year after year and will produce abundant and palatable pasturage or hay without irrigation. It furnishes succulent feed during the winter season when alfalfa is dormant.

The seed germinates quickly and readily with the first fall rains and even though the very fine-like seedlings are exposed to severe frosts, they are not injured. It grows rapidly and produces large clumps the first season.

The foliage is devoid of hairy coverings of any kind, and is free from rust, thus tending toward a clean hay and palatable pasturage. During the first season the flower-bearing stems are comparatively few and grow only about two feet high. The second season a dense loafy mass three feet high is produced with the flower-bearing stems four to six feet high, depending on the rainfall.

Feeding experiments with calves in coöperation with Woll at the University Farm show that the winter growth of the grass is very much liked and that it compares very favorably with alfalfa as a feed. All classes of stock are partial to it.

The origin of Harding Grass is obscure, and so far as known, it has not been found wild in any country. It is a perennial and withstands the climatic conditions in the great central valleys of California.

Small trial plots at Berkeley have also done well, although the growth is much slower.

Smilo Grass (Oryzopsis miliacea).—Previous names for this grass have been Many-flowered Millet, and San Diego Grass. It is one of the early introductions of the Experiment Station but its true value, according to Kennedy, has only recently been discovered. Seed is now obtainable in commercial quantities.

Experiments at the University Farm at Davis, and elsewhere indicate that it is a valuable grass, being both drought and cold-resistant, and a strong perennial. Stock eat it readily. Its nutritive value is about the same as that of Timothy.

We desire to recommend the use of Smilo Grass to increase the carrying capacity of the ranges where cultural operations are not feasible or desirable, and particularly on brush-covered slopes. It lives throughout the year where the average rainfall is as low as eleven inches

It has proven its adaptability over a wide area in the state, from San Diego to Mendocino Counties, as well as in the great interior valleys. We do not know yet whether it will withstand the winters of the northeastern counties, or the Sierra Nevada Mountains.

Napier Fodder (Pennisetum purpureum).—The more popular name for this grass is Elephant Grass. It comes to us from Rhodesia by way of Australia. In general appearance it resembles corn or sorghum, and grows from six to twenty feet high with perennial fibrous roots from which arise at the crown numerous stools, producing 40, 60 or 80 stems in a single season.

Kennedy reports that it may be cut from one to three times, depending upon the length of the season, and the available moisture. Although a semitropical plant the indications are that well-established roots will withstand the winters in such localities as the Santa Clara Valley, south to Santa Barbara, Los Angeles and San Diego, and the milder regions of the San Joaquin and Sacramento Valleys.

It is palatable to all clases of stock and as green fodder, compares quite favorably with Indian corn in nutritive value. As it does not grow readily from seed, joints or cuttings should be planted in spring in furrows after the manner of sugar cane.

Because of its enormous yield on a small area, it should be exceedingly valuable to the man who has only one or two cows on a small lot with the water supply limited or expensive.

Castor Bean.—Several analyses of the Castor beans by Albro were made for the purpose of ascertaining whether the ripe bean contains more oil than the green. This information is important, both with respect to the harvesting of the bean and the sorting of the bean. The results indicate that there is practically no difference between the oil content of the ripe and green bean.

	Ripe Beans		Green Beans	
	No. per oz.	Pct. Oil	No. per oz.	Pct. Oil
No. 1	65– 70	49.3	72– 77	50.4
No. 2	84	46.9	85– 90	46.4
No. 3	145–155	44.5	150–160	46.7
No. 4	140–150	46.1	165–175	47.5

NOTE.—Samples submitted by Professor Gilmore. Lab. No. 2994, November 2nd, 1918.

Vegetable Crop Rotations.—This project has been continued for several seasons and a large number of crop rotations were tried to find which gave the highest net returns per acre per year. Rogers reports the largest profits were realized by planting cabbage in December and potatoes in July. The second best rotation was onion seed followed by potatoes.

Drying Vegetables.—In addition to developing several new and improved methods of drying vegetables, the Zymology laboratory was active in promoting the drying of vegetables for use of the Army. A community dryer was established successfully at Santa Barbara by the laboratory.

Chemical Weed Control.—The control of morning glory by mechanical means is very expensive and in some localities seems almost impractical. In extensive experiments, particularly with the use of arsenic as a spray on the foliage, Gray obtained noteworthy results under certain climatic conditions, particularly along the coast and discovered the reasons for failure in other cases so that this method of weed eradication can now be used much more intelligently than heretofore. The two absolutely necessary conditions for success are a sufficiently high humidity at the time of application to permit the absorption of the posion before the spray dries and the maturity of the plant permitting a downward movement of the poison to the roots.

Squirrel Poisons.—An active campaign against the ground squirrel in California has given particular importance to the use of strychnine. Miller worked out routine methods of analysis for this material and analyzed large numbers of samples, causing the rejection of some tons of inferior poisoned grain which would otherwise have been sold.

Control of Ground Squirrels by the Fumigation Method.—Laboratory and field studies by Burd and Stewart indicate the superiority of carbon bisulfide over most of the substances commonly used for killing squirrels and show that the choice of methods of application should depend upon the conditions prevailing in the field and the equipment available*

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* Bull. 302.

FORESTRY

Rate of Growth of Eucalyptus.—This study was commenced by the United States Forest Service in 1912 and was taken over by the Division of Forestry of the College of Agriculture in 1916. It has now been extended to include sample plot measurements in practically all of the important eucalyptus plantations in the state. Over 90% of the total area in California planted is of the species blue gum (*Eucalyptus globulus*). The average growth of this species in 13 groves in the central coast region, as reported by Metcalf, is as follows:

Age at time of measurement	6.7	years.
Number of trees planted per acre	569	
Number of trees surviving	482	(85%)
Average annual growth per acre; cubic feet	285	
Average annual growth per acre; cords	3.17	

In 8 groves in and south of Ventura County the average growth of *Eucalyptus globulus* is as follows:

Age at time of measurement	5.6	years.
Number of trees planted per acre	692	
Number of trees surviving	519	(75%)
Average annual growth per acre; cubic feet	431	
Average annual growth per acre; cords	4.8	

The results of studies in groves of other species of eucalyptus are given below:

Species	Region	No. of Groves	Average Age	Average Annual Growth per Acre Cubic ft.	Average Annual Growth per Acre Cords
Euc. rostrata	So. California	3	7½ yrs.	95	1+
Euc. tereticornis	So. California	3	5 yrs.	74	0.8
Euc. corynocalyx	So. California	5	8 yrs.	95	1+
Euc. citriodora	So. California	1	8 yrs.	99	1.1
Euc. corymbosa	So. California	1	8 yrs.	164	1.8
Euc. punctata	So. California	1	14 yrs.	83	0.9
Euc. rostrata	Cent. Coast Reg.	2	5½ yrs.	125	1.4
Euc. tereticornis	Cent. Coast Reg.	2	3½ yrs.	117	1.3
Euc. resinfera	Cent. Coast Reg.	1	3 yrs.	65	.7

Forest Nursery Work.—The seeds of a number of native and foreign species have been planted in the nursery at Berkeley. The results reported by Metcalf indicate that several trees from central China are well suited to central California conditions. This is particularly true of *Populus tomentosa, P. simonii, P. sinensis* and *Ulmus pumila,* all of which give promise of making excellent windbreak trees; and *Zelkova serrata,* a fine street tree resembling the elms. Seed from South Africa, Madagascar and New Zealand has uniformly failed to germinate or the trees have died when transplanted.

Experiments with the seed of Bishop pine (*Pinus muricata*) to determine the vitality in seeds of the closed-cone group of pines indicate that seed just matured shows the highest germination percentage and produces the most vigorous trees and most rapid growth. Seed which had remained in the closed cones for from 3 to 15 years showed a remarkable uniformity of vitality and rate of growth.

Tests have been made with Hartley's treatment of coniferous seed-beds to prevent "damping off." Two-tenths of a fluid ounce of sulphuric acid per square foot of seed-bed, applied in water after seeding, have given good protection. In the case of fall-sown beds of Douglas fir a better stand was obtained where treatment was given one week before sowing.

Trees for Sacramento Valley.—Measurements and observation by Metcalf of 25-year-old plantations of over 100 species of trees at the Chico Forestry Station indicate that the following species are well suited for windbreak, ornamental or woodlot planting under the climatic conditions existing in the northern part of the Sacramento Valley.

Conifers: *Chamaecyparis lawsoniana, Cupressus macnabiana, Cupressus sempervirens, Libocedrus decurrens, Pinus attenuata, Pinus austriaca, Pinus coulteri, Pinus excelsa, Pinus halepensis, Pinus pinea, Pinus sabiniana, Pinus strobus, Pinus torreyana, Pseudotsuga taxifolia, Sequoia sempervirens, Thuja orientalis.*

Sequoia gigantea and *Pinus pinaster*, after making splendid growth for 25 years, are beginning to die and have evidently reached their maximum development in this climate and soil.

Hardwoods: *Acacia decurrens mollis, Arbutus menziesii, Betula alba, Celtis australis, Celtis occidentalis, Diospyros virginiana, Eucalyptus globulus, Euc. rostrata, Euc. viminalis, Fraxinus excelsior, Fraxnus oregona, Fraxinus velutina, Gleditsia triacanthos, Juglans californica, Morus alba tartarica, Quercus pedunculata, Tilia americana, Tilia platyphyllos, Ulmus fulva, Ulmus hollandica, Ulmus racemosa, Zelkova serrata.*

Fraxinus americana, Juglans californica and *Acer saccharinum* are rather badly infested with mistletoe; *Paulownia tomentosa* is subject to sun-scald on the south-west side of the trees; *Catalpa speciosa* and *Quercus suber* have made very slow growth in plantations.

Trees for southern California.—At the Santa Monica Forestry Station 78 species of eucalyptus have been planted in groves or as single specimens. Many of these are now over 25 years old. Metcalf reports that the following have made vigorous growth and seem well adapted to the existing conditions: *Euc. botryoides*†, *bosistoana*†, *calophylla**, *citriodora**, *cornuta*, *corymbosa*, *corynocalyx*†, *diversicolor*, *eugenioides*, *ficifolia*, *globulus*†, *leucoxylon**, *maculata*, *megacarpa**, *occidentalis**, *ovata*, *paniculata*†, *polyanthemos**, *pulvigera**, *punctata*†, *resinifera*†, *robusta*, *rostrata*, *saligna pallidivalvis**, *siderophloia*†, *sideroxylon rosea**, *tereticornis*, *viminalis*.

Other trees which have made good growth at this station are: *Aberia caffra, Acacia decurrens mollis, Acacia longifolia, Acacia maideni, Acacia melonoxylon, Acer macrophyllum, Angophora lanceolata, Araucaria excelsa, Celtis australis, Cinnamonum camphora, Casuarina stricta, Ceratonia siliqua, Fraxinus velutina,*

Those marked * are of interest because of the striking beauty of the flowers, foliage or bark. Those marked † have made the most satisfactory growth in plantations.

Juglans californica, Pinus canariensis, Pinus halepensis, Pinus torreyana, Pittosporum undulatum, Prunus integrifolia, Robinia pseudacacia, Sterculia diversifolia. The drouth of 1918 killed or damaged many trees which had survived normal dry seasons for fifteen or twenty years.

Bishop Pine.—An extension in the range of Bishop pine (*Pinus muricata*) was reported by Metcalf and Pratt, who observed trees near Luffenholz Creek, Humboldt County. These trees are also much larger than any thus far reported for this species, averaging about 3 feet in diameter and 125 to 150 feet in height. The average volume per tree for 71 trees cut in one area for car material was 1980 board feet. These trees averaged 80 feet in merchantable length and 37 feet in stump diameter inside the bark.

Monterey Pine.—Growth measurement by Metcalf in 12-year-old plantations of Monterey pine on the Lake Temescal watershed in the Berkeley hills show an average diameter of 6.5 inches, an average height of 25 feet and an average survival of 84% of the trees originally planted.

The Use of Lumber on California Farms.—In a study of the use of lumber on California farms, Pratt found that the wide range of species available makes it possible to choose a material well fitted for the varied requirements of the diversified agricultural pursuits of the state. The cost of wood was found to have decreased 10% from 1906 to 1915, while the average price level of other commodities was rising 33%. In 1906, 50 bushels of wheat would have purchased 1200 board feet of a certain grade of lumber, while in 1916 they would buy 2800 feet of the same material.

In many cases wood is purchased in an uneconomical way. The four prevalent mistakes made by farmers in the use of lumber are:

a. Selection of the wrong species.

b. Selection of too high a grade of lumber for the purpose intended.

c. The purchase of extra wide and full length pieces, at a high price, for cutting into small sizes which could have been obtained at a lower figure.

d. Failure to give preservative treatment to lumber in contact with the ground and hence subject to decay.

The following are found to be the principal uses of several California species:

Douglas fir: structural timbers, framing, flooring, tanks, wood pipes.

Redwood: general construction, silos, wood pipe, shingles, shakes, grape stakes, flumes, stock tanks, incubators.

Western yellow pine: interior finish, general construction, fruit boxes, drying trays, posts, poles.

Sugar pine: interior finish, silo linings, boxes, raisin and fruit trays, shakes.

White fir: cheap and temporary construction, wall board.

Western red cedar: shingles, grape stakes.

Incense cedar: posts, poles, rails, culverts, bridge planks, sills, grape stakes.

Tree Nails.—An investigation was made by Pratt in coöperation with the Department of Engineering to find a suitable substitute for black locust for tree nails, which are used to bind together the planking, frames and ceilings of wooden ships. It was claimed by various dealers that hickory and eucalyptus were suitable. Tests showed that these woods do not possess the qualities required for high-grade tree nails.

Development of a New Dendrometer.—A new form of dendrometer has been designed by Bruce by which the diameter of trees at points out of reach from the ground can be measured. It is easily portable and very accurate for a hand instrument. One of its principal advantages over most of the types previously in use is that its measurements are independent of the distance of the observer from the tree, and that the readings are direct and without computations; it is, therefore, very rapid in its use.

Alignment Graphs for Forest Formulas.—Graphs of the alignment type have been prepared by Bruce for the following frequently occurring formulas of forest mensuration:

Huber's and Smalian's formulas for the volume of a log.
Schiffel's and form factor formulas for the volume of a tree.
Smalian's formula applied to entire trees when cut into logs.

Since all these formulas contain three or more variables, graphs of the conventional type using rectangular coördinates are very inconvenient or entirely impracticable. The alignment method so simplifies the charts that they permit of a material saving of time and labor wherever repetition of any one of these formulas is involved. Their accuracy is within the limits requisite for forest measurements.

The Determination of Cellulose in Woods.—A study has been made by Dore of methods of chemical examination of woods with particular regard to cellulose and its separation from the hemicelluloses. Numerous modifications have been practiced of the recognized standard method of determining cellulose by chlorination. It has been found that modifications involving the use of either acid or alkaline hydrolysis previous to chlorination result in a diminished yield of product. The diminution in yield is not due to a purification of the product, but to a destruction of true cellulose of the highest type. The use of hydrolytic agents is therefore inconsistent with the requirements of a precise cellulose method. As a result of this study, limitations have been suggested for previously proposed definitions of cellulose.

MISCELLANEOUS CROPS AND PRODUCTS

The Carob.—As a result of an extensive study of the carob, or St. John's bread a bulletin by Condit has been prepared. The tree is a handsome evergreen. producing its flowers on the larger and older branches year after year in October and November. Most of the trees are dioecious, but some seedling trees in California produce perfect flowers which develop pods in abundance. The carob tree is comparable to the loquat which blossoms and sets fruit in the winter. The successful production of pods in the interior valleys is therefore limited to the citrus belts along the foothills. Seedling trees are planted in the desired location and budded over to known varieties two or three years later. The buds should begin to bear three years after budding. Yields from seedling trees in southern California fifteen to twenty-five years old vary from 150 to 400 pounds per tree.

Analyses of the Carob Bean.—During the period 1916–1919 forty analyses of different varieties of carob beans were made at the Nutrition Laboratory with a view to obtaining the variations in composition and the nutritive value of the pod.

The pods analyzed averaged one-third of an ounce in weight, with variations from one-quarter to one ounce. The seeds averaged 11 per cent of the bean.

The principal value of the carob bean lies in its sugar content. The results of the investigation show a maximum of 51.98 per cent of sugar in the pod, of which 43.6 was sucrose and the remainder reducing sugars. The minimum per cent noted for the bean is 20.73, the average 34.4. Although sucrose was found to predominate in most varieties, several yielded more reducing sugar than sucrose.

It was also noted that where the percentage of seeds was low, the percentage of sugar was high. Because of their hardness and low percentage, the seeds cannot be considered as contributing in any material way to the nutritive value of the bean.

Although the pods are not suitable for extraction of sucrose for commercial purposes, they are deemed a valuable food for cattle and swine. The statement that the beans contain quantities of tannin sufficient to render them unfit for animal food was proved to be unjustified by a careful examination of several samples. Only a trace of tannin was found.

The high per cent of sugar makes the carob bean an excellent source of energy for the animal body. For this reason it is a valuable feed for work horses. The most desirable form in which this could be utilized is that of a meal because in such a condition more nutriment could be rendered available to the animal from the seeds than in any other way. In some varieties, however, grinding is not feasible on account of the appreciable per cent of gums which tend to clog the grinding machine. In such cases it would be desirable to treat the beans as one would grain when it is to be rolled. In this way the pods would be broken and the seeds more or less crushed, thus enabling the digestive juices of the animal to better attack them.

The large amount of sugar which some of these varieties contain renders them a very valuable food for fattening when used in connection with some material rich in protein.

The Buckeye and the Acorn.—It has long been known that both the California buckeye and the acorn were used by the Indians as staple articles of food, but both contain tannin and other bitter principles which must be removed. The treatment of the acorns is much simpler than that necessary for the buckeye, which must be treated with a weak solution of lye while water is adequate for the acorn.

It was found for buckeye that one per cent lye solution is sufficient. If the nuts were peeled the strength of the solution could be reduced to eight tenths of one per cent. The whole nut should be dried, coarsely ground, and treated overnight. The lye can then be washed out and the material dried and preserved for future use. Better results would be obtained if the nuts were first peeled before processing, because the skin is much less valuable than the interior of the nut and contains a much higher per cent of the bitter principle than does the peeled nut. An ordinary kitchen meat-grinder will serve for preliminary treatment and a coffee mill for final grinding after processing.

Ground processed buckeyes, to the extent of 25 per cent of the mash, was successfully fed to chickens as a substitute for part of the bran and shorts usually used. The substitution referred to must be made gradually. The buckeye fed was the processed unpeeled nut. More buckeye could probably have been fed if the peeled nut had replaced the unpeeled.

The analysis of the buckeye shows that it contains from 60 per cent to 75 per cent of water; from 2 per cent to 4 per cent of protein, and from 20 per cent to 30 per cent of carbohydrates, the chief ingredient of the latter being starch. In this respect the composition of the buckeye approaches somewhat that of the potato. It would be difficult to state definitely the yield of buckeyes for any particular season, but some observations made would seem to warrant the statement that a large buckeye tree in full bearing should yield about two hundred pounds of nuts a year.

Rice By-Products.—A number of samples of rice bran and rice polish from different mills were examined by the Division of Nutrition. The protein content of rice bran varied from 9.94 to 12.53 per cent, with an average of 11.44 per cent. The corresponding data for rice polish are 7.97, 9.80 and 8.70 per cent respectively. The rice bran is also rich in fat, as evidenced by the figures 10.26, 20.66 and 15.80, representing minimum, maximum and average, respectively. The rice polish rates far lower in fat than the bran, the average fat per centage being 9.5.

On account of the high content of fat in these products there is a tendency toward rancidity. Two forms of adulteration may occur: One, admixture of hulls, and the second, admixture of the refuse used in the coating of the rice grains after milling. This refuse is mainly carbonate of lime. So-called rice bran showing upwards of 40 per cent of mineral matter has been found on the market. High-grade rice bran should not contain 10 per cent of mineral matter.

The Digestibility of Whale Meat.—Mattill concludes as a result of artificial digestion experiments that raw whale meat is slightly less well digested at two and one-half hours than raw beef, and slightly better at four hours. In the cooked condition, whale meat is a little more quickly and completely digested than beef. The fact that particularly lean beef was chosen, and that whale meat is lower in fat than ordinary meats, emphasizes this advantage. It may then be said, conservatively, that whale meat is as easily digested as any other meat.

The following figures show that whale meat is slightly richer in protein than the average beef, but much lower in fat than the lean meat.

Analysis of Whale Meat

Water, per cent	71.22
Ash, per cent	1.20
Protein, per cent	23.13
Fat, per cent	4.24
Undetermined, per cent	.21
	100.00

Bacillus Botulinus: Canned peas containing lemon juice, as recommended in Circular 158, were inoculated by Cruess with spores of *B. botulinus* and then heated in boiling water for three hours. No bacterial growth or toxin was produced. Canned peas without lemon juice and treated in the same way developed typical bacterial growth and sufficient toxin to kill guinea pigs. Similar results were obtained with canned corn and fish.

SOIL INVESTIGATIONS

Nitrification.—The limiting plant food element in California soils is nitrogen, but the capacity of California soils to effect nitrification is abnormal in certain respects, as previously shown by Lipman. Kelley finds in laboratory tests made in the conventional way that California soils frequently fail to convert concentrated organic fertilizer into nitrate. However, in previous laboratory studies on nitrification, the proportions of nitrogenous materials that have been added to soils have been excessive. With the use of such proportions as are commonly applied in the field, nitrification takes place rapidly. It appears, therefore, that the limiting factor in crop production can scarcely be the incapacity of the soil to effect nitrification. It is more likely to be the inadequacy of the nitrogen supply, coupled with improper distribution of nitrate.

Virgin soil at Riverside and soil from plots treated with inorganic fertilizers through a period of years, or unfertilized, are unable to effect the nitrification of 1% dried blood, but treatment with manure or cover crops for a number of years has so changed the soil as to permit active nitrification of 1% dried blood. Plots treated with dried blood or bone meal have so affected the soil as to permit the formation of nitrites from 1% dried blood, but nitrate is still produced only feebly. Previous treatment with potash and phosphate fertilizers registers no effects on nitrification in this soil. The addition of lime and gypsum produces only slight effects. However, all of the common nitrogenous fertilizers undergo active nitrification in these plots when applied in quantities approaching field applications.

It has been found that straw manure and grain straws need to undergo decay for several months before active nitrification sets in. Barley straw effectively retards the nitrification of commercial fertilizers that otherwise undergo active nitrification in the absence of the straw. After the lapse of a few months, however, nitrification again becomes active. These results suggest the advisability of fall and early winter applications of manure, instead of spring applications.

The products of nitrification, as well as of decaying organic matter in general, bring about notable increases in the solubility of the calcium in California soils. but produces much less effect on other constituents. These products tend to combine with carbonate, if present, and with the ubiquitous hydrous silicates, with the resulting liberation of notable amounts of calcium. It is doubtful whether the solubility of soil phosphate or rock phosphate is affected by nitrification in the field.

Furrow irrigation tends to bring about zones of high nitrate only a few inches removed from zones of very low nitrate. Generally speaking, nitrate tends to accumulate near the surface between irrigation furrows and is not adequately carried down below the depth of cultivation, owing to the existence of compact subsoil or plowsole. An abundance of decaying organic matter and cover crops is the best remedy. Application of fertilizers before the close of the rainy season is also suggested.

The effect of soluble salts on soils.—Investigations conducted by Kelley indicate that sodium salts set calcium free from the silicates of soils, equivalent amounts of sodium becoming insoluble. The extent of the replacement is proportional to the concentration. The reaction conforms to the mass action formula and is reversible. The degree of replacement is widely variable in different soils, being greatest in heavy and least in sandy soils. Potassium and ammonium salts produce similar effects. Calcium salts replace magnesium, while magnesium salts replace calcium to a greater extent than monovalent salts. Such anions as Cl, SO_4 and NO_3 are only slightly absorbed by soils. PO_4 is absorbed to some extent and considerable amounts of CO_2 may be converted into HCO_3 without the intervention of biochemical action.

Soils, neutral as shown by the hydrogen electrode, have the power of neutralizing considerable amounts of sodium carbonate. Heavy soils have this power to a greater degree than light soils. When such sodium salts as NaCl or $NaNO_3$ are passed through a soil, then followed by water, highly colored solutions are obtained, as shown by Sharp. The colored solutions may be acid and contain notable amounts of organic matter. But so long as the concentration of sodium in solution remains above a certain point, only very limited amounts of organic matter are dissolved. Similar treatment with solutions of calcium salts or with water, does not yield colored solutions.

The increased solubility of the organic constituents appears to result from: (1) The solution or replacement of calcium originally combined with the organic matter. (2) The removal of the calcium by leaching. (3) Hydrolysis after the concentration of sodium has been sufficiently reduced. It is possible that the organic substances are insoluble in solutions of sodium salts, but soluble in water.

New Studies on Soil Acidity and Conditions Affecting It.—Results obtained in the laboratory of Soil Chemistry and Bacteriology and corroborated independently and simultaneously by two or three workers in this country have settled a controversy that has long agitated the scientific world. Proof is given that "soil acidity" really is caused by an excess of free acid (hydrogen ion) and is not caused by adsorption or similar little understood phenomena. Modifications were made in special apparatus for the accurate determination of hydrogen ion (acidity), which had been originally devised for work in physical chemistry. Conditions affecting the determination of hydrogen ion have been studied and accurate information obtained.

Studies on Variability in Soils.—Waynick has demonstrated that soils may vary strikingly within the smallest distances at which they can be sampled practicably. This has been appreciated by few investigators in its general aspects and suspected by none as regards the magnitudes of variability. Thus, in very small areas of what are considered the most uniform soil, there was found very large variability in the nitrate content and in the total carbon and total nitrogen content. It has been demonstrated that only systematic sampling of soils, involving the taking of large numbers of samples properly distributed through a given area and computations made statistically, is at all adequate to the task of proper soil study.

The Relative Availabilities of Nitrogenous Fertilizers in Nitrogen-Poor California Soils.—Several years ago, Lipman and Gericke demonstrated that on sandy soils of this state which are characteristically deficient in both total and effective nitrogen, the important high-grade nitrogenous fertilizers are not equally available. This finding has recently been confirmed in specially-planned careful greenhouse experiments. The Oakley blow sand was used and barley was the crop grown. Ammonium sulphate was shown repeatedly to be superior to all other nitrogenous fertilizers tested on that soil. Nitrate of soda was next in order, and then calcium nitrate, dried blood, high-grade tankage and steamed bone-meal, which were very similar in their action.

Sulfur as a Factor in the Productivity of Our Nitrogen-Poor Soils.—In a new series of pot experiments, Lipman and Gericke repeated the work above described, and included a parallel series in which sulfur was added to the nitrogenous fertilizers not containing it. The quantities of sulfur used were equivalent to those contained in the sulfate of ammonia employed. As a result of this investigation, it was found that the Oakley soil yields just as much barley with nitrate of soda plus flowers of sulfur as it does with sulfate of ammonia alone, which proves the need of sulfur there. Sulfur applied without nitrogen gives no results and, of course, the biggest part of the benefit, even when sulfur is used with nitrogen, comes from the latter.

Lipman and Gericke found that with barley grown on the Oakley sand in pots nitrate of soda gave best results when applied four to six weeks after the crop had been planted. Applications made after ten weeks were without result. For some unknown reason, other nitrogenous fertilizers did not show the periodicity in effect just noted for nitrate of soda.

Further Studies on the Causes of Good Spots in Poor Grain Fields.—Attempts made by Lipman to determine the cause of the good clumps of grain in poor grain fields which are known to all acquainted with grain fields, have resulted as follows: The soil within the good spots was always from 6 to 10 times as powerful in the production of nitrates as that just outside the good spots among the poor grain plants. This was found to be uniformly true for four widely different kinds of soil. It was the only difference between the good and poor spots in the grain, which was common to all the soils studied. On this basis, the hypothesis has been promulgated that the poor growth of grain plants in the fields in question is due to a lack of available nitrogen at certain important stages in the growth of the plant. This hypothesis has since found ample support in the results of Gilmore with available nitrogen applications to experimental plots on two widely different soils, viz., a humus loam on Roberts Island in the delta and a sandy soil deficient in organic matter at Glendale in Los Angeles County.

Availability of Peat Nitrogen.—So much activity has recently developed in California in the sale of peat for soil improvement that a greenhouse experiment was started by Lipman to determine of what value peat nitrogen is, if any, and how it compares with standard nitrogen fertilizers. Much work of this kind has been done with humid soils, but practically nothing with arid soils. Barley was the test crop grown in pot cultures. The soil used was the Oakley sand, which responds readily to any form of ''fertilizer'' nitrogen. Peat was used in three forms, viz., untreated, treated with steam under pressure for three hours, and treated with weak sulphuric acid and then with steam under pressure. No significant differences were obtained between the controls and the peat-treated cultures, while the same kind of soil and plants treated with nitrate of soda (200 pounds per acre) gave an increase over the control of 250% in yield of dry matter and those treated with sulfate of ammonia (150 pounds per acre) gave even a larger increase (about 275%). The amounts of peat used corresponded to the amounts containing nitrogen in the same quantity as that of 200 pounds nitrate of soda per acre. This shows peat to be practically useless as a source of available nitrogen to crops on our nitrogen-poor soils.

Burd also reports that peat, unlike farmyard manure, does not decay rapidly in the soil and is not readily nitrifiable. Its use as a fertilizer is not advised.

Bacterial Flora of New Soils.—A study has been made of calcareous or limey sands from one of the islands off the Florida Coast in order to determine what kinds of bacteria become the first inhabitants of new soil material. This is of interest in connection with all soil bacteriological problems. Lipman and Waynick found that one group of the nitrogen-fixing bacteria, *Azotobacter,* is present in such soils, that the nitrifying power is practically nil, and that several species of *Actinomyces* unknown as yet and probably new, have established themselves in that soil material. The numbers of bacteria found were surprisingly large, considering the medium is a white, coarse, limey sand almost devoid of organic matter.

Bacteria in Deep Soil Layers.—Publications of Lipman in past years have indicated that at least certain groups of bacteria penetrate to greater depths in California soils than in humid soils. To confirm and establish this finding, more results were needed and for that, in turn, a less laborious method of sampling was necessary. By a careful comparative study of sampling by auger and by the old laborious method described elsewhere, it was found that ordinary precautions in auger sampling permit of obtaining the same results as with the more laborious time-consuming and costly method heretofore employed. This being established, twelve more soil columns of six feet in depth were obtained by the auger method and the samples studied in the laboratory. The results confirm the older findings to the effect that ammonia-producing, nitrifying, and nitrogen-fixing bacteria penetrate to greater depths in arid than in humid soils. In addition, it has been found that a number of our soils are very poor in bacterial flora in the surface soil, but are not much poorer in that respect in the subsoil. The nitrifying power in all soils is most marked in the surface foot, a sharp contrast existing between that and the nitrfying power of even the second foot.*

How Gypsum and Lime Affect the Solubility of Potash and Other Elements in Soils.—Lipman and Gericke have shown that both lime and gypsum may increase the supply of soluble potassium and of other minerals in some soils and not in others. The kind of a system formed by soil and water and the nature of the silicates present apparently determine in every case what effects are obtained from a gypsum or lime application. These results dispose of the controversy which has been agitating agricultural scientists for many years. Even up to the present, papers proving that gypsum and lime do, and others proving that they do not, increase the soluble potash supply of soil are appearing in print. Both are evidently right from the results, which reconcile the two views and prove that the advocates of one or the other have merely been looking at ''one side of the shield.''

Bacteria as Decomposers of Soil Minerals.—Under Lipman's direction Wright has furnished proof that bacteria are capable of dissolving considerable quantities of minerals and, therefore, doubtless are concerned in the supply of available minerals to plants. The experiments conducted proved that the acid produced by bacteria, chiefly carbonic acid, is responsible for the solvent effects noted, and, what is more important, that the general laws of chemical equilibrium applying for a system of any acid with a mass of mineral, hold for a system of mineral plus a nutrient solution containing bacteria.

By What Steps Does Azotobacter Fix Nitrogen.—Recent experiments by Waynick and Woodhouse show that a very large percentage of the total nitrogen fixed in the first few days of growth of Azotobacter in culture consists of amino-acid nitrogen. This proves that the elementary nitrogen goes through the simple organic forms before it is made into protein forms. It also proves, what is perhaps most important, that the nitrogen is fixed by combination with hydrogen and not with oxygen, thus insuring much greater economy of energy as theoretical chemistry shows, than that of the electro-chemical processes. Moreover, the results show that, contrary to common belief, not sugar, but products of its decomposition form the true source of carbon for energy for *Azotobacter.*

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* Soil Science, vol. 6, no. 2, p. 131. Univ. Calif. Publ. Agr. Sci., vol. 4, no. 4, p. 113.

Effect of Season and Crop Growth on the Soil Extract.—Stewart has made a detailed study of the water-soluble nutrients in a group of typical light and heavy soils. Notable effects were observed upon most of the principal elements as a result of the growth of barley crops. The changes in planted soils were compared with the conditions existing in uncropped fallow duplicates. The growing crop reduced the nutrients in both good and poor soils to a comparatively low level. The differences in production were shown to be affected by differences in capacity to produce water-soluble nutrients. The changes in the water extract were shown to reflect variations in the actual soil solution which nourishes the plant. Supplementary studies connected with the investigation show that large amounts of water-soluble nutrients are developed by cultivation, fallowing and biennial cropping and demonstrate the soundness of these practices.

Variation in the Soil Solution.—The new method of determining the concentration of the soil solution by the freezing-point depression, as suggested by Bouyoucos and McCool, has been applied by Hoagland to a number of soils held under conditions of exceptional control. The conclusion is reached that the concentration of the soil solution varies during the season and is diminished significantly by the growth of a crop. The effect produced by the crop may persist for a long time It is suggested that there is a definite correlation between water extracts of soils and the soil solution. This lends added importance to the method of studying soils by means of water extracts.

Water Extractions.—Burd made a comparison of the magnitudes of the soil constituents withdrawn by a crop from a productive soil with the water-extractable constituents of thirteen soils with and without crop. It was shown that the ratio of water-extractable matter in cropped soils to the concurrent draft was relatively large in the case of all constituents. The differences between the magnitude of water-soluble nitrate and basic ions (K + CA + Mg) found in uncropped soils and those found in the cropped soil plus the plant draft were always greater in the more productive soils; suggesting a certain value of water extractions as a criterion of crop-producing power. Comparison of the more usual methods of chemical examination of soils, on thirteen soils of known production, indicated that the seasonal averages by water extraction give figures more in accord with the soils' present crop-producing power than any of the other methods. No correlation could be observed between physical classification and crop production. The great variation in crop yield and in the figures for water extractions within a given series and class (soil type) is taken to indicate that physical classification into types is inadequate as a means of predicting probable yields or determining fertilizer requirements.

Absorption of Soil Constituents at Successive Stages of Plant Growth.—The composition of barley grown on two different soils was studied by Burd at successive stages of growth. In spite of differences in the character of the soils and the yields obtained, a striking similarity was observed in the growth cycles and in the successive changes in the rates of absorption of the plants. Attention is called to remarkable losses of potassium and nitrogen from the plant at an early stage of development, which are succeeded by renewed absorption at a later period. The losses observed occurred when the constituents of the water extracts of the soil were at or approaching their minima and when these same constituents were moving from the leaves to the heads. The suggestion is offered that high concentrations of the soil solution at certain stages of growth of many plants are probably not necessary and may be undesirable. The absorption of nutrient elements at all stages of growth of the plant have been studied by Hoagland. It appears that for plants of the cereal type at least the critical period of absorption only extends over the first half of the growth cycle. The final yield of crop is probably largely dependent upon a suitable concentration and supply of nutrients during this period. It is not necessary nor desirable that a large supply of nutrients be provided during the latter part of the growth period. A nutrient or soil solution of low concentration may be optimum if the solution is continuously replenished as absorption by the plant proceeds. The conclusions reached, based on sand and water-culture experiments, are in accord with studies made on plant grown in the soil as described by Burd. The investigation has also brought out numerous points of interest to students of plant nutrition too technical to be described in a brief paragraph.

The Effect of Irrigation Waters on the Osmotic Pressure and Reaction of Various Soils.—The effect of different types of irrigation water on different soils has been investigated by Hoagland and Christie. The recently devised methods for determining the concentration and reaction of the soil solution have been applied. It was found that the effect of any irrigation water depends on the nature of the soil and the reaction taking place therein. Other factors being equal, it seems evident that an irrigation water may produce a much more injurious effect on a sandy soil than on a heavy one.

Plant Nutrition Studies.—The investigations of the past year have greatly clarified our ideas as to the nutritional requirements of growing plants. One of these has shown that certain plants, of which barley is a type, not only do not require a high concentration in the soil solution at certain stages of growth, but that low concentrations at such stages are probably desirable and hasten the maturation of the crop. A number of studies with sand and water-culture solutions have developed a technique for use in the propagation and optimal development of plants which has proved extremely successful in such work. One of the more important ideas developed by Hoagland has been that plant growth is probably more dependent on the presence of adequate total amounts of solutes in the soil than to high concentrations therein.

The trend of the investigations on soils has been on the effects on the soil itself and the soil solution, of irrigation waters, manures, and fertilizers. The effect of such additions has been measured by various methods which have shown their adequacy in this respect and constitutes an important step in advance of the old idea that the small quantity of solutes present in such substances could not so modify the character of the soil as to produce measurable results.

Effect of Manure on Soil Solution.—Hibbard reports that the admixture of fresh manure with soils results in the temporary reduction and almost complete disappearance of nitrates from the soil. At the same time there is a marked reduction of the water-soluble constituents found in the unmixed materials. One or the other or both of these facts probably account for the lack of immediate improvement observed in field soils to which fresh manures are applied. Later, however, soils so treated show a marked increase in water-soluble constituents including nitrates, suggesting that the ultimately soluble ingredients of manure may account for increased crops apart from any effect of the manure on the physical texture of the soil.

Banana Stalks as a Source of Potash.—Billings and Christie report that banana stalks contain notable quantities of potassium and indicate further that this may be extracted in the form of potassium carbonate of a high degree of purity.

Potash from Tule.—Hibbard has shown that tule plants, which occur very extensively in marshy areas in this state, contain appreciable quantities of potassium, sufficient, in fact, to justify the expectation that the values obtainable therefrom would contribute materially to the cost of reclamation of such lands.

ALKALI INVESTIGATIONS

Survey of Irrigation Water Supplies.—The irrigation waters in use throughout the citrus and walnut belt have been analyzed by Kelley and his assistants. The major portion of the water is of excellent quality. A considerable portion, however, contains alkali. The impure supplies are widely distributed from the Mexican border well into Tulare county. For the most part, the poorer waters come from wells. In a few cases as much as two tons, and in a still greater number of cases from one-half to one ton, of alkali is being added to the soil per acre per annum. The effects of the more impure supplies are already proving serious. Several hundreds of acres of citrus and walnut groves, some of which are located on excellent soil, have been severely injured. Investigations show that citrus is quite sensitive to alkali and walnut trees still more so and the use of irrigation water containing alkali will ultimately produce injury to either.

No definite remedy can be offered at present. It may be possible to ward off the injury for a time by good culture and the heavy use of manure and gypsum, but the time will come when serious injury will result in spite of these precautions. Good drainage is the most important consideration where impure water must be used. Rarely, if ever, is natural drainage sufficient. But it is doubtful whether any soil can be kept permanently suitable for citrus or walnuts, where alkali irrigation water is applied. The purity of irrigation supplies is a matter of great practical importance.

Chemical Treatment of Alkali Land.—Lipman and Sharp report that in an experiment carried on at Kearney Park, an attempt was made to apply to an alkali tract of forty acres the results obtained on small plots as explained in the report of this station, 1915–16. About fifty tons of strong sulfuric acid were sprayed on the forty acres, leaving a number of untreated strips of land at intervals, to be used as controls. A statistical study of the data obtained the first year shows a clear improvement in the productive power of the soil through the treatment, but one not great enough to justify the sulphuric acid treatment in practice. The effect of the acid treatment seemed to become less the second year and showed a tendency to disappear altogether. Treatment of a part of the forty-acre field with sulfur gave no results. Much of the difficulty militating against the greater success of the sulfuric-acid treatment is to be traced to the constantly rising water table, with the accompanying concentration of salts in a thin layer of soil. It is obvious that when the salt content of a soil reaches a certain point, no chemical treatment can change the soil so as to produce normal plants.

Improvement of Soils Injured by Alkali.—In soil cylinders at the University Farm, to which alkali salts had been added, it was found by Lipman and Sharp that the soil was soon markedly injured by the leaching effect of the rain on the salts. In wet weather, the soil is sticky and impervious to water and air. In dry weather, it has the consistency of a brick. Plants refuse to grow under such conditions, but by the addition to such soil in varying quantities of ammonium sulfate, ferrous sulfate, gypsum, and sulfuric acid, good growth of grain was obtained.

The Effect of Barnyard Manure on Alkali.—A pot experiment was carried out by Lipman and Gericke in the greenhouse to determine whether or not manure applications to soil prevent the injurious effects of alkali salts to barley. Large and very injurious quantities of the single salts, sodium chloride, sodium sulfate, and sodium carbonate, were added to the clay adobe soil in the pots. Five successive crops were grown. Applications at the rate of 20 or more tons of barnyard manure per acre show very striking powers of preventing partly or wholly the injurious effects of the alkali salts in that soil. The effect of the manure becomes less and less as season follows season and the 20-ton application seems almost without effect in the fifth season.

Heavy Metals as Preventives of Injury by Alkali Salts.—Previous work in the laboratory of Soil Chemistry and Bacteriology and in a few others in this country, had shown that one salt itself poisonous alone, may have the power of preventing injury to living organisms by another poisonous salt. This discovery was used as a basis for further experiments with barley grown in pots of soil in the greenhouse, with heavy metals used to antagonize or to protect against the common alkali salts of the light metals. The results obtained show that copper, lead, zinc, iron, and manganese sulfates may prevent any injury or any considerable injury to barley by common salt, sodium sulfate, or sodium carbonate, when these are used at toxic concentrations.

Further Evidence that Antagonism Between Ions Is Connected With Cell Permeability.—Waynick has obtained direct evidence that antagonism between ions is accompanied by reduced permeability of the cell membrane. This was done by an analysis of the ash of plants grown in solutions which were toxic and in those in which antagonism prevailed. Very striking results were obtained which showed, to take but one example, that when potassium chloride is used in a nutrient solution alone, abnormally large quantities thereof or of some other element present are absorbed by the plant. When, however, calcium chloride, even in small quantity, is added to the potassium chloride, relatively very little potassium, or of the other mineral elements, is absorbed. This may prove also of very great significance in alkali problems.

Kearney Vineyard Experimental Drain.—The 160-acre tract at Kearney Park upon which tile drains were installed in 1914 is still in a rather unsatisfactory condition. As previously reported by Weir the summer of 1915 was given over to attempts to eradicate the Bermuda grass which had become troublesome.

In 1916, the tract yielded 180 tons of barley and oat hay. The following year alfalfa was planted, but owing to the lack of rain a very poor stand was obtained. Irrigation later failed to produce a crop and Bermuda grass again became troublesome. In 1918 approximately 200 tons of hay, a mixture of alfalfa and Bermuda grass was obtained the stubble afforded fair sheep pasture for a period. In 1919, 120 acres were plowed and sowed to oats, yielding only about 35 tons of poor hay; the remainder of the tract is ready for planting to corn. The hay stubble, consisting mostly of Bermuda grass, is affording some sheep pasture. The eradication of Bermuda grass is a very serious problem on this tract and until it can be satisfactorily handled there is little hope of obtaining good yields of cultivated crops.

EXPERIMENTAL METHODS

The Casual Variability of Fruit Tree Yields.—Field trials are extensively used to determine the value of a given treatment or to test the productiveness of varieties. A casual examination of the reports of such trials usually shows a wide range in the reliability of the results. It is recognized that the results of a single experiment are often untrustworthy. Field trials cannot be expected to give results of such reliability that they will be invariably obtained when the trial is repeated. The best that can be done is to construct the most probable results from the observed varying results of individual trials. Though it is impossible to obtain perfect accuracy, it is possible to fix the limits of error and to determine whether the differences obtained are due to the treatments applied or to unavoidable errors. Batchelor and Reed have determined the casual variability in the yields of orange, lemon, walnut, and apple orchards with especial reference to its bearing on the value of plot trials. They found that the regular distribution of four plots, each consisting of 8 trees, over the area tested was a satisfactory means of reducing the probable error of the mean yield, and was better than a grouping of 32 trees in one continuous plot. With the plots of 16 to 32 adjacent trees which were studied, a difference of from 63 to 82 per cent of the mean plot production would be necessary in order to obtain chances of 10 to 1 that the results were due to differential treatment and not to casual variability in the productivity of the trees. With the same number of trees in scattered units, a difference of 28 to 50 per cent would be necesary for the same odds. In any system of field experimentation where a standard of comparison is necessary, the theoretical or ''normal'' yield of a plot is a question of importance. One may use the average yields of the control plots of the entire area, or of the nearest control plots, or a combination of the two. In cases studied, the coefficient of variability was reduced 50 per cent by use of the nearest controls in place of the mean of all controls.

Critical Studies on Culture Solutions for Plant Growth.—The culture solution, because of its relative simplicity of composition, must remain for sometime the medium for the study of problems in plant physiology and soils. Heretofore, however, it has been employed without due regard for the errors which inhere therein. Waynick has attempted to eliminate the errors in the method and to appraise past work in the light of such errors. Briefly stated, the results show that the size of containers for culture solutions has been too small in the past. Further, it is shown that differences between "good" and "poor" solutions, such as those of Shive, almost disappear or lose significance when studied on a statistical basis. Also, that the season is an important influencing factor as to differences between the same "good" and "poor" solutions, the differences being much greater between the two in the late spring than in the winter under greenhouse conditions at Berkeley. The variability in the growth of the plants in the poor solutions is much greater than that of the plants in the good solutions.

A New Method of Obtaining the Soil Solution.—Simple, direct, and seemingly efficacious method of otaining the soil solution, has been devised by Lipman. This consists in subjecting the soil with optimum moisture content to high pressures (20,000 to 30,000 lbs. per square inch) and collecting the expressed liquid for filtration and study. A special container for the soil was devised for the purpose. This problem of obtaining the soil solution and studying it has been and still is one of the most difficult and important in the field of soil study.

ENTOMOLOGICAL INVESTIGATIONS

Silk Culture.—The climate of California is suitable for commercial silk growing and there is an unabating interest in the question of the possible firm establishment of this industry in this state. A special study was made of the varieties and methods of growing silk in China by Woodworth, who conducted a school at the University of Nanking at which men from every province in which silk is grown competed for a prize, using eggs from their own locality and the most approved methods of their own districts. This study confirmed the idea that with our present cost of labor silk raising cannot be commercially profitable in California.

Mosquito Control in China.—A special study of the problem of mosquito control presented by the low lands of the Yangtse Valley was made by Woodworth and the practical use of the ordinary inspection net as a means of control was demonstrated. There are many cases in the control work in California in which the same method would be practical. In China the sole dependence in the whole campaign was the use of this instrument and the results secured were as good as those obtained by any other methods elsewhere. The territory covered in this experiment included everything inside the walls, a circumference of 25 miles, involving the bi-weekly inspection of more than a thousand ponds, besides many ditches and canals. It also included quite a large area in rice paddies, the observations on which are probably significant in the study of the mosquitoes in the rice districts in California.

Mosquito control in the Dismal Swamp, Virginia.—While in charge of the sanitary work at the Port of Embarkation at Newport News, Herms was able to demonstrate the practicability of drainage for mosquito control under conditions of scarcely any fall, in which drainage canals would rather be looked upon as a means of concentrating the water than of carrying it off the land. Since mosquitoes thrive only in small pools this drainage work was almost as effective as that which occurs where the water can be drained off. The result of this work was the absolute elimination of malaria at the port of embarkation camps.

Fumigation of Food Products.—Quite extensive experiments were carried on by de Ong in the fumigation of grains, seeds, and various food products, especially with carbon bisulfide. Extensive data on a number of lines which had not been previously sufficiently investigated are now available: such, for instance, as the effect of gas on the germination of the seeds, which was found to be quite negligible even with excessive treatments, and the amount of decrease in the dose when specially built fumigatoriums are used; thus 3 to 5 pounds of carbon bisulfide per 1000 cu. ft. were found sufficient, while in improvised fumigatoriums often 10 to 30 pounds were required to obtain good results.

Insects in Cold Storage.—One of the leading methods of protecting food products from insect attack is to place them in cold storage. de Ong obtained considerable data on the length of time the various insects are able to survive exposure to different degrees of refrigeration. All of the rice weevil, *Calandria oryzae,* were killed within a month except in one case. The dried-fruit moth, *Plodia interpunctella,* were all dead in two months but larvae of the darkling beetle, *Tenebrio molitor,* can live over three months. We have no record of their living for four months.

Identification of Insects.—One of the difficulties in the correct naming of insects on the Pacific Coast is the fact that most of the type specimens are in eastern Museums. Van Dyke made special studies in these museums, particularly in Coleoptera, settling authoritatively a considerable number of uncertainties of this kind. About two thousand species were thus very carefully compared of which about fifty were found to have been misunderstood and therefore incorrectly named by Pacific Coast entomologists. Part of these have already been published in a series of systematic papers and all of these errors will shortly be thus corrected. Most of the errors are concerning species of minor importance and they are largely insects attacking forest trees.

Liquid Cyanide Investigations.—There has been a very great change in the application of cyanide as an insecticide involving a number of important scientific questions. Gray made an extensive study of the chemical and physical properties of the liquid cyanide and originated a method for determining the concentration by the use of the thermometer and specific-gravity spindle. He also investigated the action of cyanide upon metals and was able to determine the most valuable materials for use in constructing the liquifying apparatus, containers and atomizing machines. Aluminum, tin, nickel, copper, brass and another alloy were found to be satisfactory. Lead, iron, and zinc are bad.

Insecticide Statistics.—The value of insecticide used in this state has recahed the sum of $3,000,000 per year, according to statistics compiled by Gray. These are the most complete figures of this kind ever brought together and represent over 95% of the acreage in fruit in California. One-third of this amount is spent for cyanide; the next largest use of economic poisons is about one-half a million spent annually for sulfur.

Honey Survey.—The desirability of increasing our output of honey by finding suitable localities for new apiaries was the occasion for a survey by Coleman of the forest area of Santa Cruz County and a partial survey of the National Forests of Monterey and Santa Barbara Counties. This resulted in laying out a very large number of desirable sites. In Santa Cruz some 47 sites were located, of which about 25 are now occupied or about to be occupied.

The Beet Leafhopper (*Eutettix tenella Baker*).—Investigations conducted by Severin in the Death and the Antelope Valleys, Mojave Desert and Imperial Valley showed that the beet leafhopper is rarely found on desert vegetation and hence the enormous swarms which invade the beet fields do not migrate from desert breeding areas. The natural breeding area of the pest in the San Joaquin Valley are the plains and foothills. In October, 1918, the dark adults flew from the cultivated districts to the plains and foothills where they undergo an incomplete hibernation during the winter. The dark females of the winter brood deposit their eggs in Red Stem Filaree (*Erodium cicutarium*) growing on the plains and foothills and the pale green adults of the spring brood invade the cultivated regions after the pasture vegetation becomes dry. In the cultivated area of the San Joaquin Valley the leafhopper has been bred from 35 different weeds, in which the eggs were deposited under natural conditions. Thirteen of these weeds belong to the beet family (*Chenopodiaceae*). Twelve species harbored the curly-leaf disease. In April, 1919, three enormous swarms flew into the beet fields, one in the southern part of the San Joaquin Valley, another in the central portion of the valley and the third in the northern section. It is evident from this investigation that the cultivated area of the San Joaquin Valley is practically free from bugs from November to April and hence sugar beets should be planted in November, December or January, so that the foliage covers the rows before the beet leafhoppers come into the beet fields in April. The most serious objections to planting early are as follows: (1) the young beets are sometimes destroyed by frost, necessitating replanting; (2) about 75 per cent of the beets planted in November, 50 per cent in December, and 15 per cent in early January develop seed stalks, slightly reducing the sugar content, and furthermore, these beets are woody and difficult to slice.

PLANT BREEDING

The Relative Superiority of Good Plants.—Any large population of plants, such as a field of corn or an orchard, contains many individuals which are much larger than the average and others which are smaller than the average. Two questions at once arise: ((*a*) Are the variations such as might be due to the effect of purely casual factors of the environment, such as soil or water, or are they so characteristic as to indicate that their causes exist in the genetic fabric of the plant? (*b*) Are the larger individuals superior from the beginning or are they merely ordinary individuals which grew longer and finally attained more than average size? Reed has studied the growth of an annual plant (sunflower) with reference to these questions. It was found that the variations in size were not such that they could be classed as variations due to pure chance, i.e. to casual variations in the soil, or water, or other external conditions. Plants which were small at maturity were generally small from the beginning, and those which were large at maturity showed a well-marked superiority from the start. There is evidence that height is determined by factors which are distributed at random through the population. It was found that the distribution ofthe relative heights of the plants was fairly equal. Further support for the assumption is found in the fact that the tallest and the shortest plants were less variable in regard to their mean relative height than plants more nearly average height.

Heredity in Radishes.—Frost has studied the inheritance of certain characters in radishes. F_1 hybrids secured show the dominance of colorless plastids in the petals over the yellow plastids of *Raphanus raphanistrum,* of red and black root colors over white, etc. Lines selfed for two generations were commonly much inferior in size and vigor to F_1 hybrids. Self sterility appeared to be general but variable in degree.

Bean Breeding for Dry-Land Conditions.—Studies by Frost on "pure lines" of white-seeded Tepary beans have shown striking differences in various characters. Of the beans grown commercially in California, only the Blackeye bean (cowpea) approaches the Tepary in resistance to heat and drouth. A search is being made for varieties of beans which are more acceptable to the ordinary consumer than those mentioned, and which are either specially resistant to hot weather and drouth or able to set a crop before summer weather begins. Earliness and resistance to bean rust seem to be varietal characteristics of special importance.

The Oak-like Walnut.—Babcock has demonstrated that the oak-like walnut, *Juglans californica* var. *quercina,* although strikingly distinct from the parent form, *californica,* in all its gross characters, exhibits simple Mendelian behavior when crossed with it. The normal form is dominant in F_1, and the *quercina* form reappears in F_2 in about one-fourth of the plants. A parallel mutation from the northern black walnut, *J. hindsii,* has been discovered and described. It has been named *J. hindsii* var. *quercinifolia,* and apparently bears the same relation to *hindsii* as *quercina* does to *californica.*

Tobacco Breeding Investigations.—Setchell has studied a large number of different varieties of *N. Tabacum,* and finds that five of them may be considered as fundamental varieties. Illustrations and taxonomic descriptions of these fundamental varieties of *N. Tabacum* and of other species and forms of *Nicotiana* have been published. The hypothesis of Comes that the many diverse commercial varieties of *N. Tabacum* are hybrid derivatives from a few fundamental types has been tested by Setchell, Goodspeed, and Clausen. A large number of crosses have been made between the fundamental varieties of *Tabacum,* and the hybrid progenies have been studied through as many as ten generations. The results show:

a. That derivatives may be obtained from hybrids which represent any combination of the characters of the original parents.

b. That derivatives may be obtained which exhibit characters not apparent in either parent, although the elements for their production must have been derived from the parents.

c. That after four or five generations of self-fertilization the derivatives breed true, and they continue to breed true and behave like pure lines thereafter.

d. That the differences between the fundamental varieties of *Tabacum,* although complex, are essentially Mendelian and capable of analysis. Practically, these experiments demonstrate that it is a relatively simple matter to breed new varieties of tobacco, and that it should take not more than seven or eight years to obtain in a stable variety almost any combination of characters of any two varieties.

Species Hybrids.—Investigations of Goodspeed and Clausen have resulted in the formation of a definite hypothesis which, it is believed, will aid in the interpretation of such phenomena as the "mutation" behavior of *Oenothera,* bud variation in horticultural plants, and the complex relations exhibited in species hybridization. The main points of this hypothesis may be outlined as follows:

a. The hereditary units of species form complex but harmonious reaction systems, the specific elements of which are the factors of Mendelian heredity.

b. Strict Mendelian inheritance follows hybridization between forms which have fundamentally like reaction-systems. The Mendelian behavior is a consequence of the existence of specific differences in certain elements in the common reaction-system.

c. When fundamentally different, but equivalent, reaction-systems are contrasted, as in some species hybrids, the elements of the two systems may not be interchangeable as in Mendelian hybrids because the diverse elements may form inharmonious reaction-systems. These inharmonious systems either may not function at all or may function in an abnormal fashion. The results of this difficulty are expressed in a variety of ways, particularly in the marked sterility of species hybrids and in the production of abnormal individuals.

SEED PRODUCTION EXPERIMENTS

Production of Sugar Beet Seed.—In the spring of 1918, experiments were started by Webber and Batchelor, as a war measure, in the production of sugar beet seed in southern California. The preliminary trials made in 1918 indicated that the best results could be expected from certain sections near the coast where the "curly top" disease does not cause serious damage. Variety tests also made during this season comparing domestic seed with imported seed of various of the best known European strains gave results indicating very forcibly that equally good yields of sugar can be obtained from home-grown seed.

Possibility of Vegetable Seed Production in Central California.—Rogers has demonstrated that it is possible to produce the following seeds in commercial quantities in this region: beet, carrot, cabbage, cauliflower, onions, celery, lettuce, swiss chard and radish. The yields and quality were very satisfactory. Spinach, turnip, kohlrabi, and rutabaga seed gave very undesirable results.

Influence of Size of Beet Steckling upon the Quantity of Seed.—In these experiments conducted by Rogers four sizes of beets were used varying from 1 or 2 inches to 8 or 9 inches in diameter. The results from the first year's experiments showed that a medium size beet from 3 to 4 inches in diameter produced the largest quantity of seed. This investigation is being continued and the results given should not be considered as final.

DAIRY CATTLE

Alfalfa as the Sole Feed for Dairy Cattle.—The investigation of the effects of long-continued, exclusive feeding of alfalfa to dairy cattle was commenced in 1914 with six pure-bred dairy heifers. The following year another group of six grade yearling calves was added. Three animals in each group have since been fed nothing but green alfalfa or alfalfa hay, and the other three have been fed mixed rations of alfalfa, silage and concentrates. The main results obtained up to December, 1917, in this investigation, which has been conducted by Woll, have been published elsewhere.*

The gains in body weight made on mixed rations were 20% larger than on alfalfa, on the average for both groups of heifers, and this result is also corroborated by the body measurements of the animals under experiment which have been taken periodically during its progress. The calves dropped by the heifers and cows on the mixed rations have been uniformly heavier than those from the alfalfa-fed dams, the difference in the average birth weight being 8% in favor of the former calves.

Up to the present time data for fifteen complete lactation periods have accumulated, viz., 6 each first and second lactation periods and three third lactation periods for both lots. The average increase in the production of butter-fat on the mixed rations over that for alfalfa rations per lactation period was as follows: 1st period, 45%; 2nd period, 9%; 3rd period, 22%, or an average of 25% for all lactation periods in favor of the mixed rations. The average production of the cows for all lactation periods was:

For alfalfa rations: 6,491.5 lbs. milk; 258.86 lbs. butter-fat.

For mixed rations: 7,336.8 lbs. milk; 323.37 lbs. butter-fat. The cost of the two rations will vary according to the feed prices during different seasons. With relatively low prices for alfalfa, say, less than 40% of that of grain feed, the average gain in production may not be sufficient to pay for the higher cost of the mixed rations, but the influence of the latter system of feeding on the thriftiness and body condition of both cows and calves must at any rate be considered of sufficient importance to commend it to both breeders and practical dairy farmers.

Alfalfa and Succulent Feed for Dairy Cows.—This investigation, likewise conducted by Woll, is supplementary to the preceding. It was begun three years ago, the plan being to feed heifers of similar type and age alfalfa only in comparison with rations composed of alfalfa and green feed, silage or roots. The following average data for the production of the two lots of heifers have been secured up to the present time.

Average production per Lactation Period

	Milk	Butterfat
Average for 8 heifers fed alfalfa only	6,373.0	223.19
Average for 6 heifers fed alfalfa and succulent feeds	7,239.7	256.90

This shows a difference of 14% in the average production of milk and 15% in the average production of butter-fat in favor of the heifers fed alfalfa and succulent feeds.

The Influence of Barley on the Milk Secretion of Cows.—Feeding experiments with fifteen cows in the university dairy herd were conducted by Woll and Voorhies for a series of years with a view to ascertaining whether there is any foundation in fact for the opinion held by some farmers, that barley has a tendency to dry up the cows.† The feeding of barley as sole concentrate was continued for one to three complete lactation periods in the case of three cows and for shorter periods in the case of a dozen other cows, alfalfa hay and silage or green forage crops being fed in addition. The results of the experiments showed conclusively that barley is an excellent feed for dairy cows and that there is no reason to suspect any deleterious influence on the milk secretion when the rations fed contain sufficient nutriment for the production of the cows. The use of this cereal in dairy rations, as well as stock feed in general, is to be recommended when it is not needed as a food for man, and when its market value makes it an economical stock feed in comparison with other concentrates.

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* Paper read at the annual meeting of the American Society of Animal Production, December 28, 1917; Journal of Dairy Science, vol. 1, no. 6, March, 1918, pp. 447–461.

† The Influence of Barley on the Milk Secretion of Cows, by F. W. Woll and E. C. Voorhies, Cal. Exp. Sta., Bull. 205, February, 1919, pp. 325–334.

Silage Crops for Dairy Cows.—Studies of the value of silage made from Indian corn, sweet sorghum, milo, feterita, and Sudan grass were conducted by Woll and Voorhies.* Through the addition of Indian corn silage or milo silage to rations of alfalfa or alfalfa and grain feeds, an increase in production amounting to from ten to twenty-five per cent was secured in feeding experiments with cows in the university dairy herd, and the efficiency of the rations per unit of dry matter furnished was improved by about ten per cent. Rations of alfalfa hay, with or without grain feeds, supplemented by Indian-corn silage, Sudan grass silage or sweet sorghum silage, produced similar amounts of milk and milk components.

Investigations of Milking Machines.—Investigations of milking machines in the university dairy herd conducted by Woll during the past three years have shown that the modern milking machine is a practical and safe labor-saving device; it gives as good results as regards the production of milk and butter-fat during entire lactation periods as does hand milking, provided the milking is done with equal care in either case. There are at present eight different makes of milking machines on the market in this state that may confidently be expected to give satisfactory results in the hands of careful operators. The saving in the cost of milking by machine over hand milking is greater in the case of large herds than with small ones and will, in general, be in proportion to the size of the herd. While machine milking has no appreciable effect one way or the other on the dairy production of the cows or on the general health of the herd, with proper care and careful prompt hand stripping, as compared with milking by hand, machines will not longer render satisfactory service with careless handling and lack of cleanliness. They are, therefore, most likely to prove successful when operated by the owner himself or by help directly interested in their success.

Feeding Dairy Calves in California.—The value of a number of concentrates for feeding skim milk calves was studied in experiments conducted by Woll and Voorhies, viz., grain mixtures consisting of barley, oats and wheat middlings, with and without linseed meal, milo and barley with and without linseed meal, barley shorts and linseed meal, carob pods and milo vs. barley and milo, and dried beet pulp and barley vs. cocoanut meal and barley. The results are presented and discussed in a bulletin published in the fall of 1916.†

Whole vs. Ground Grain as Feeds for Young Dairy Calves.—Two trials were conducted by Woll and Voorhies with calves in the university dairy herd during the early part of 1917, one lasting 14 yeeks with 12 calves one to three months old, and the other lasting 9 weeks with 10 calves two to five months old. The lots were fed by the reversible method and received skim milk, alfalfa hay, and a grain mixture composed of milo and oats in the proportion of 3 to 2, by weight, in the first trial, and the same feeds mixed 3 to 1, by weight, in the second trial. The average daily gains on the first trial were 2.02 lbs. for whole grain and 1.99 lbs. for ground grain, and the averages for the second trial 1.82 and 2.13 lbs., for whole and ground grain, respectively. The calves consumed the following amounts of feed per 100 lbs. gain in body weight, as the average for both trials:

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* Trials with California Silage Crops for Dairy Cows, by F. W. Woll and E. C. Voorhies, Cal. Exp. Sta., Bull. 282, August, 1917, pp. 19–40.

† Feeding Dairy Calves in California, by F. W. Woll and E. C. Voorhies, Cal. Exp. Sta., Bull. 271, September, 1916, pp. 17–44.

On whole grain: 71.9 lbs. grain, 297 lbs. alfalfa hay, 861 lbs. skim milk, and 7.9 lbs. whole milk.

On ground grain: 67.4 lbs.grain, 260 lbs. alfalfa hay, 785 lbs. skim milk and 9.3 lbs. whole milk.

The lots fed whole grain required 353 feed units per 100 lbs. of grain, and those fed the ground grain 320 lbs., as the average of the two trials, a gain of 10% in favor of the ground grain mixture. Considering the cost of grinding small grains like milo and oats, it would appear therefore that there was no appreciable advantage found in grinding the grain for young dairy calves.

Oat Hay vs. Alfalfa Hay for Skim Milk Calves.—An experiment with fourteen young dairy calves was conducted by Woll and Voorhies during the winter of 1918, in which the relative feeding value of alfalfa hay and oat hay was studied. The calves were fed skim milk and a grain mixture consisting of 150 lbs. dried beet pulp, 100 lbs. each of barley and wheat bran, and 50 lbs. cocoanut meal, in addition to either alfalfa hay or oat hay, both of which were fed *ad libitum*. The hay fed the two lots was reversed during the second half of the trial period of twelve weeks. Both lots of calves made somewhat larger gains when fed alfalfa hay than on the oat hay, although the feed consumed was somewhat lower during the alfalfa period than for the oat period.

The total gains in body weight were 871.5 lbs. for alfalfa hay and 826.0 lbs. for oat hay. Per 100 lbs. of increase in body weight the feed consumed was as follows:

On alfalfa hay: 290 lbs. hay, 922 lbs. skim milk and 73 lbs. concentrates.

On oat hay: 308 lbs. oat hay, 986 lbs. skim milk, and 78 lbs. concentrates. According to the feed-unit system, two to two and a half pounds alfalfa hay and six pounds skim milk have a similar feed value as one pound of grain. On a basis of these figures it may be assumed that about 2.6 lbs. oat hay represent one feed unit, against an average of 2.2 for alfalfa hay. The palatability and general value of the two kinds of hay, aside from their nutritive effects, did not differ materially, both kinds being excellent feeds for dairy calves when of good quality

Utilization of Cereal Straw and Milo Stalks for Dairy Stock.—An investigation was conducted by Woll during the fall of 1917 for the purpose of ascertaining the value of barley straw and milo stalks for feeding dairy stock. Eighteen heifers and twelve dry cows were fed alfalfa hay and barley straw, about two-thirds of the usual amount of hay being provided and as much straw as the animals would clean up. After a 50-day feeding period the lots were changed to alfalfa and milo stalks delivered from the threshing machine.

The average daily ration eaten by the heifers was 11.7 lbs. alfalfa hay and 2.6 lbs. barley straw, on which feed they made an average gain of 59.86 lbs. in fifty days. The corresponding data for the dry cows was 15.0 lbs. alfalfa hay and 5.8 lbs. straw per head daily, with an average gain of 60.5 lbs. per head during fifty days. The trial with the milo stalks showed that the heifers ate on the average 12.2 lbs. alfalfa hay and 7.7 lbs. stalks and made an average gain of .57 lb., while the dry cows ate 13 lbs. alfalfa and 14.8 lbs. milo, gaining .53 lb. per head daily.

DAIRY PRODUCTS

Protein in Milk.—Jaffa reports, as an average of 60 analyses of cow's milk collected from different dairies supplying milk in San Francisco, 3.26 per cent of protein, as compared with 3.80 per cent reported by Babcock for eastern cows. In 40 analyses of California goat's milk, the average value obtained for protein was 3.58 per cent against the high value of 4.29 per cent given by Koenig. The ratio of casein to albumen for the goat's milk was found to be greater than that given by Babcock for cow's milk.

Cooling Milk and Cream.—A comparison of the efficiency of different types of milk coolers indicates that the tubular cooler and other types which cause agitation of the milk as it passes over the metal surface will reduce the temperature of the milk to within two degrees of the temperature of the water, if the milk is passed over the cooler with the proper flow of the size of the cooler used. Well water at Davis has a temperature of 68° F., while the water from a covered tank is above 68° during the summer months. Where ground water can be pumped directly through the cooler while the milk is being cooled, a lower cooling temperature during warm weather is possible.

Cottage Cheese.—Since Cottage Cheese is an economical meat substitute and can be made from skim milk which is ordinarily used only for animal feeding the Dairy Industry Division started the commercial manufacture and marketing of cottage cheese with a view to demonstrating the correct method of handling this product on a large scale. The special equipment recommended for manufacturing this product is now in daily use at the University Farm Creamery, where from 500 to 600 lbs. of cottage cheese is manufactured and shipped each day. Skim milk from the separator is pasteurized at a temperature of 145° F., cooled and starter added. Fourteen hours later the curd is cut with regular cheese knives, cooked, drained, and salted. It has been found that a cooking temperature not to exceed 93° F. produces a softer, more palatable cheese and is more satisfactory if the cheese is marketed quickly. A drain rack made of heavy-mesh galvanized wire, mounted on rollers has hastened the time required for draining, so that in hot weather it may be placed in the refrigerator without deterioration. Parchment-lined paraffined boxes are the most economical shipping containers.

The yield of cottage cheese manufactured by this method has varied from 17 lbs. to 19 lbs. per 100 lbs. of skim milk, depending upon the cooking temperature.

A fairly satisfactory grade of Cheddar cheese was made by pasteurizing the milk and then ripening it with a culture of *Bacillus Bulgaricus.*

Cottage cheese made by Baird and Marquardt from mixtures of sweet buttermilk and skim milk was found to be of satisfactory quality. A palatable cottage cheese can be made exclusively from buttermilk if the acidity of the latter is below .3%. The quality of cheese made was more satisfactory when a mixture of *Bacillus-Lactis acidi* and *Bacillus Bulgaricus* starters were used in the proportion of 9 to 1 to make up the one per cent of starter than when the common lactic acid starter was used alone.

Cheese Making.—When using gassy milk for making California (Granular) cheese, Baird found that a pure culture of *Bacillus Bulgaricus* used as a starter was more effective than *Bacillus Lactis Acidi* in controlling undesirable fermentations. The cheese made with a *Bacillus-Bulgaricus* starter and ripened for two and one-half to three months was of better quality than cheese made with *Bacillus-Lactis-Acidi* starter and held under similar conditions. The flavor of the *Bacillus Bulgaricus* cheese was not uniform and in some cases undesirable flavors resulted.

There seemed to be little difference in the results obtained by the use of different cultures of *Bacillus Bulgaricus.*

By using a mixture of *Bacillus Bulgaricus* and *Bacillus Lactis Acidi*, there was little improvement over the straight *Bacillus-Lactis-Acidi* starter. The best results were obtained, by using a one per cent *Bacillus Bulgaricus* starter.

Pepsin and Curdalac in Cheese Making.—Pepsin and curdalac have been used by Baird as a rennet substitute in cheese making since these substances have been less expensive and more available than rennet. The cheese made from pepsin and curdalac gives no material change in flavor but they have a marked effect upon the body of the California (Granular) cheese by causing corkiness. The cheese does not break down after curing. It contains about the same percentage of moisture as rennet cheese but has a dry appearance and feeling. This defect seems to be caused by a lack of acid. Pepsin requires the presence of acid and since California (Granular) cheese is a sweet-curd cheese, the necessary acid is not developed. Pepsin is more dependent upon the presence of acid for coagulating milk than rennet. A mixture of one-half rennet and one-half pepsin gives satisfactory results.

Pickling of butter.—Small quantities of butter were stored very satisfactorily by Denning by placing two-pound squares wrapped in parchment paper into a solution of salt (NaCl). A twenty per cent solution prepared by adding 2 lbs. of salt to each gallon of water was satisfactory for use. The butter was placed in stone jars, weighted down and the solution then added. Fresh butter of good quality pickled in this manner and stored at 50° F. remained in good condition for a period of eight months. Butter kept in pickle at warmer temperatures cannot be depended upon to keep in good condition longer than three or four months.

Body of Butter.—In comparing the score on the body and moisture content of 473 samples of butter entered in the California Educational Butter and Cheese Scoring Contests, Denning found that a low moisture content does not necessarily indicate a good body and that a good body can be obtained in butter containing the maximum legal amount of moisture.

HOGS AND SHEEP

Alfalfa Pasture with Grain vs. Alfalfa Pasture Alone.—A very common method of growing hogs for market in this state is to pasture them for several months and then to finish the hogs on grain. This method was used by

Thompson and Voorhies in comparison with full feeding of grain on pasture. One lot was self-fed from weaning; the others pastured during the entire growing season, and then finished on grain. The first lot reached market weight in approximately one-half the time required by the others. They were on pasture only 42 days, compared with 258 days for the second lot, and when ready for market had consumed less grain.

Pork Production with Grain and Alfalfa Pasture.—Self-feeders were used in comparison with hand-feeding. Thompson and Voorhies report that as in previous experiments self-feeders proved economical both as savers of feed and of labor. Cut green alfalfa, fed in a dry lot in comparison with pasture, showed a saving in alfalfa area but more grain was required for each pound of gain, and the rate of growth was slower. The use of supplementary feeds, such as tankage, shorts, and cocoanut meal in conjunction with barley proved to be economical. Milo maize proved ten per cent more efficient than barley.

Milo Maize and Barley for Pork Production.—The cost of threshing and grinding milo maize is sometimes very high. Thompson and Vestal report that threshing, or threshing and grinding, would need to be done quite cheaply, as the cost of this work would otherwise be more than the value of the grain saved. In this test the relative value of milo and barley was reversed, compared with the previous trial, barley proving ten per cent more efficient than milo.

Skim Milk vs. Whey in Pork Production.—In two separate trials Thompson, Vestal, and Voorhies found that unskimmed whey has about three-fifths as much feeding value as skim milk for fattening growing pigs after they weigh sixty pounds or more.

Rations for Pork Production.—A daily ration of one per cent, two per cent, and three per cent of the average live weight of the pigs was fed in comparison with a full ration. The results from this one test are not conclusive, but the general principles seem to be as follows: That lighter grain rations compel the consumption of more pasture, the result being that the amount of grain consumed for each pound of gain is less, but the rate of gain is much slower than when the hogs are full-fed. Thompson, Vestal, and Voorhies conclude that there is little difference in the total amount of grain consumed by the time the hogs reached market weight, and that more pasture has been required for the ones fed the lighter grain ration. The advantage, therefore, would seem to belong to the lot selling on the highest market, a condition decidedly difficult to forecast.

Source of Protein for Fattening Hogs.—Thompson used skim milk, milkoline, tankage, and fish meal in feeding trials with fattening hogs. The gains from milkoline were negative. The average of two tests showed tankage slightly superior to fish meal. The results also indicate that skim milk is worth about one-sixteenth as much per pound as either tankage or fish meal.

Silage for Fattening Lambs.—Miller reports that silage and hay proved to be a very unsatisfactory ration for fattening lambs, barley and alfalfa hay giving the most satisfactory results in every way. Different varieties of silage were used. In order of economy of gains feterita silage was first, sweet sorghum second, and milo third.

Rations for Fattening Lambs.—Miller concludes that when lambs are worth 7c per pound average barley stubble is worth about 75c per acre for sheep grazing. The use of cocoanut meal and cottonseed meal as supplements to a ration of barley and alfalfa hay was economical. The proportion was two of barley to one of meal. Alfalfa meal and molasses produced desirable gains but was too expensive. With mutton at 7c per pound this feed was worth $10.00 per ton.

Roughages for Fattening Sheep.—Barley and alfalfa hay with silage proved more economical than barley and hay alone as reported by Miller. Less grain is required with such a ration, but the carcasses do not show quite so much covering. Milo silage was most efficient; sweet sorghum silage second, and corn silage third. Alfalfa hay as a sole ration was unsatisfactory in every respect.

Spineless Cactus for Sheep.—Miller concludes that Spineless Cactus is not a desirable feed for sheep. It is not especially palatable and the gains are less than those produced by corn silage.

Fattening Old Ewes for Market.—Old ewes cannot be profitably fattened for a very considerable period. Miller reports that a ration of silage and alfalfa hay is satisfactory, but that more rapid daily gains can be secured by the addition of a small amount of beet pulp.

Garbage Utilization by Feeding.—Through the activity of anti-hog-cholera serum distribution, the Division of Veterinary Science is in touch with most of the hog raisers who feed garbage in the state. During the recent campaigns for food conservation, a considerable saving was brought about by assisting hog feeders in obtaining some of the large amounts of garbage which are wasted in our cities.

In order to have some data to use in these efforts toward conservation, a garbage-feeding test was carried out in Oakland with the following results:

Duration of the test (June, 1917, to January, 1918)	28	weeks
Total amount of garbage collected	10,814	lbs.
Average number of families contributing each week	18.6	
Average number of persons per family	3.65	
Average number of pounds of garbage per day per person	.786	
Total gain in hogs fed exclusively on garbage	409	lbs.
Total gain in body weight per ton of garbage	75.6	lbs.

Following is the observed composition of the garbage:

Fruit, fruit peel, melon rind, etc	61.2%
Vegetables, vegetable peel, greens, etc	34.7%
Bread, pastry, rice, cereals, etc	2.4%
Meat and bone	1.7%

About 4% of the above garbage proved inedible, as it consisted of lemon and orange peel, onions, fibrous stems and bones. Restaurant and hotel garbage contains much more bread and meat and, on account of its high feeding value, is eagerly sought by swine feeders.

Owing to the increased interest in food conservation, there has been a marked decrease in the quantity of city garbage and the nutritive quality has also decreased, nevertheless the number of hogs fed has constantly increased because of the increasing utilization of kitchen scraps that were formerly wasted or rendered inedible by being mixed with glass, paper or trash.

Before anti-hog-cholera serum came to be so generally used, garbage feeding was a precarious business and the price of garbage was low. Through the efforts of Petersen, who is in charge of the manufacture of serum at the university plant, most of the feeders in the San Francisco Bay region now immunize all their hogs. This and the increase in the price of pork have caused more garbage to be fed. The result has been to increase the price of garbage For example, the receipts at one hotel for the privilege of removing the kitchen refuse have recently increase from $40 to $600 per year, although there has been no increase in the weight of refuse sold.

POULTRY

Artificial Lighting Increases Winter Egg Production.—Dougherty found that the use of artificial lighting to increase the length of the hen's working day in winter would produce a decided and profitable increase in winter egg production, provided sufficient lights were used to illuminate the scratch floor and mash hoppers so fowls could easily see to scratch and eat. The use of metal reflector shades on lights to concentrate the light on floor and feed hoppers was found of value in increasing the efficiency of each light used.

Pens of fowls in which electric lights were used daily, in morning only, from 4:30 A.M. to daylight, for the months of November to February inclusive, as compared with pens in which lights were used at night only, from dusk to 8 P.M., and with other pens lighted both morning and night during same hours, gave most profitable results. The hens in the pens lighted only in the morning not only laid as well but no dimming arrangement was needed to get fowls on roosts at end of lighted period each day. The cost of a dimmer was saved as well as time required to operate it.

The pens lighted in morning only did not molt at end of "lighted" period; the pens lighted only at night went through a light molt; the pens lighted both morning and night molted rather heavily.

Fowls began to respond to lighting at about 7 days and at four weeks the full effect of the lights was secured.

The use of artificial lighting cannot be said to stimulate egg production in the same sense that condiments, excess amounts of concentrated high-protein feeds, etc., do. The lights simply improve the winter environment of the hen by increasing the number of hours in which she can exercise and eat and by decreasing the number of hours she must remain on the roost. In brief, artificial lighting establishes summer-day conditions in winter as far as hours of light are concerned.

Time of Hatching Pullets.—As a result of investigations to determine the effect of time of hatching on molting and egg production in the pullet year, Dougherty found that pullets hatched before the first of the year generally molt the following fall, but that the fall molting of pullets hatched after that time was governed largely by methods of care and to some extent by fall weather conditions. While prolonged mild weather in fall might induce early hatched pullets to molt, stimulation for extra early laying by the feeding of concentrated high-protein feeds is the biggest factor. The young pullet must have time to develop her body (the egg machine) as she will otherwise invariably be stunted in size or in vitality, or both.

Pens of pullets hatched in January, February, March, or April yielded fairly similar gross receipts from eggs produced till 14 months of age. However, since the intensely hot weather of late spring and summer which may prevail over a large part of the state tends to retard the growth and increase the mortality of young stock, it is economically desirable in these localities to hatch early and secure the benefits of the cooler later winter and early spring weather in getting the chicks fairly well grown before the hot days arrive.

Knock-Down Poultry House.—In order to stimulate a more widespread keeping of back-yard flocks in towns and suburban districts for the purpose of conserving the food supply as a war measure, by feeding kitchen and table waste to such flocks and turning a product otherwise wasted into eggs and table poultry, Dougherty in coöperation with Belton, designed a knock-down poultry house and yard to fit the special needs of the back-yard poultry keeper. It was believed that a small house and run which made the work of caring for a few hens so simple that a small amount of time each day on the part of even a 12-year-old boy or girl would be sufficient to secure good results would be a means of inducing many more people to put in back-yard flocks. It was built knock-down so that it could be moved as easily as a piece of furniture and thus meet the needs of those living in rented dwellings.

The continuous demand for plans has fully emphasized the value of such a house. It has also proved to be an excellent colony brooder and rearing house for poultry raisers in general and very convenient for special breeding pens.

Yards vs. Confinement of Laying Hens.—Yarding investigations by Dougherty indicated that continuous confinement of laying hens to the laying houses is detrimental to their health and best productive effort. Over a two-year period, small flocks of 34 to 40 hens each which were entirely confined to the laying houses gave much poorer egg yields than similar flocks yarded at the rate of approximately 600 per acre. The same decrease in production occurred when flocks of 300 hens each were confined, as compared with similar flocks yarded at the rate of 1100 per acre. The difference in production of these large pens, however, was not so pronounced because the flocks used were much larger and the yards for the yarded fowls smaller. The number of sick birds and the death losses were larger in the confined than in the yarded flocks.

Rice Feeds for Poultry.—Feeding investigations by Lloyd indicate (1) that rice bran which is sweet and free from hulls can be used as a satisfactory substitute for wheat bran in an amount not to exceed 20% of the mash; (2) that paddy rice, when used not to exceed one-third of the grain ration for adult fowls is a nourishing grain for poultry and has no injurious effect due to the gritty hard hulls; (3) that rice polish does not make as satisfactory a substitute for wheat shorts as for ground barley. Ground rice feeds are apt to turn rancid as they age so that they should be fed with care. Their value for poultry feeding will depend largely upon whether they can be purchased at less cost than more common poultry feeds.

Home Egg Preservatives.—In an extensive series of tests, Lloyd found that the three best ways of preserving fresh eggs at home are (1) submersion in a solution of 5% waterglass and 95% boiled or distilled water, (2) submersion in a solution of limewater and salt, (3) anointing the surface of each egg with lard or with one of the commercial grease preservatives.

The method of anointing eggs with a grease is limited in practical value, however, because satisfactory results may not be secured unless the preserved eggs are stored in a rather cool, even temperature. This method is convenient in that eggs can be stored in egg cases, cartons, boxes, etc., but considerable time and labor is required to grease the eggs so that every part of shell is coated. If eggs are incompletely greased they will spoil.

Waterglass solution and a solution of lime water and salt were found to give good results under all conditions usually met with in both city and country homes. It was shown to be beneficial, however, to keep the eggs in as cool a place as possible.

Methods of coating eggs with waterglass paste, with paraffin or with any other coating that hardens, and packing eggs in dry salt proved worthless.

Smutty Wheat for Poultry.—Repeated tests by Lloyd have indicated that the stinking smut of wheat does not seem to be injurious to the continued health or productiveness of laying hens when fed alone or in a mixture of grains in connection with a good mash mixture. The mortality was no greater in the flocks fed smutty wheat as the sole grain diet than in the check pens fed no smutty wheat and the egg production was just as good. The pens fed smutty wheat, however, did consume somewhat more feed per hen. This was probably due to the fact that the smutty wheat contained less nourishment per pound than good plump grain free from smut.

ANIMAL DISEASES

Thermal Reaction Following Intradermal Injection of Tuberculin.—Investigations of this station have pointed out that the intradermal injection of tuberculin in suitable doses gives rise to a thermal reaction similar to the one obtained by the subcutaneous method. The intradermal dose used by the California State Veterinarian in official testing .2 c.c. of 5% solution of alcoholic precipitated tuberculin, is sufficient to bring forth this result. The practical application of these observations is evident. One can, by one injection, make use of two diagnostic manifestations of tuberculin application, namely, general reaction as indicated by rise in temperature and a local reaction. The San Francisco County Medical Milk Commission has recently adopted this method of testing for additions to herds producing certified milk. The subcutaneous test was formerly used.

Combined Tuberculin Tests.—Traum and others have demonstrated that any of the methods of turberculin testing (subcutaneous, intradermal or ophthalmic) will fail to detect an important percentage of tuberculous animals. They have further demonstrated that tuberculous cattle, while giving negative results to one form of tuberculin application, may give positive results to another form. Therefore, the combining of two or more tests has been suggested.* The combination which appears most effective is the sensitized ophthalmic with the intradermal test, at the same time making a record of the thermal reaction resulting from the latter injection.

Late Local Reaction to Intradermal Test.—Most freuently positive local reactions can be observed at 36 or 48 hours after the injection of tuberculin, but a constant, though very small, percentage of cases will not show definite reactions until later. On several occasions during the past five years, there appeared instances where a large percentage of reacting animals failed to show definite reactions at 36 or 48 hours, but showed such later. An intradermal test applied to 45 cattle in April, 1919, at the end of 48 hours showed two definite reactors, 5 cattle with slight but observable thickenings, and two with indurations not larger than B. B. shots. At 96 hours, not only did these 9 animals show definite positive reactions, but 8 other animals which had shown no appreciable thickening at 48 hours, gave well defined reactions. No explanation is offered for such results, which are not the rule but, nevertheless, occur occasionally. They emphasize that early examinations alone can not be depended upon to give correct results. Two observations are recommended, the first at 48 or 60 hours, and the second at 96 or 120 hours.

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* Hart and Traum, Journal American Veterinary Medical Association, vol. 50, p. 189.

When only one observation can be made, we have made it at 72 hours, others prefer 96 hours. Some reactions do not occur until after the 72nd hour, but we are not satisfied that there is not an equal or larger number of cattle in which definite positive reactions have been present but disappeared before the 96th hour.

Complement Fixation Test.—This method of diagnosing tuberculosis in man has received new impetus following the reports of Miller & Zinnser. Their findings especially appealed to us since the active cases gave marked degree and high percentage of fixations, and it is in this class of tuberculous animals that the tuberculin test has its highest percentage of failures.

Traum in coöperation with Dr. J. V. Cook of the University of California Medical School applied the complement fixation test to 244 cattle sera; in many cases re-tests were made. Autopsy records were obtained in all cases. Of 46 cases of severe tuberculosis 43, or 93.5%, gave positive results and 3, or 6.5%, gave no fixation.

Of 55 cattle with slight or moderately severe localized lesions, 10 sera, or 18.8%, gave positive results while 45, or 81.81%, gave negative results.

129 sera from cattle showing no tuberculous lesions on postmortem showed 12, or 9.3% positives, while 117 were negatives.

7 of the tuberculous and 7 of the non-tuberculous sera were anti-complementary and were not included in above figures.

The 9.3% of non-tuberculous cattle showing positive results argues against the universal adoption of this diagnostic method, especially in large and in valuable herds.

It may be that with more complete history of these animals an explanation for some of these reactions could have been found.

Our work on 20 hogs indicated that the complement fixation test is of no value in diagnosing tuberculosis in these animals.

Making Cattle Environments Free from Infective Tuberculous Material.—The conditions under and the influence to which tubercle bacilli from tuberculous cattle are exposed outside of the animal body are many, and, in our experiments, it has been our aim to represent the most important of such, especially as they obtain in California.*

In two series of experiments Traum has found that, when tubercle bacilli from lungs of infected cattle were exposed in a 1 in. thickness of manure on the ground, they were alive, in one series, at the end of 140 days and, in the other, at 71 days. In the first series, they were dead at 171 days and in the second at 94 days.

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* Traum, Journal American Veterinary Medical Association, 1917, vol. 52, pp. 289–299.

Tubercle bacilli, exposed in the first series, retained their virulence for guinea pigs for over two months longer than those in the second series under practically the same conditions. These results are in accord with the findings in our other experiments. The facts to bear in mind are that the two experiments were planted two months apart and that in both cases the tuberculous material became innocuous soon after the rains stopped, when they were no longer kept moist. There appeared to have been very little weakening of the tubercle bacilli during the rainy season.

A third series was carried out to determine how long tubercle bacilli would live when exposed to California climatic influences when no rains intervened and to what extent cattle would become infected with such materials. Seventeen days after being placed in the experiment plot, tuberculous material exposed in 1½ in. thickness of manure was no longer able to produce tuberculosis in either guinea pigs or in cattle. The guinea pigs were given direct inoculations, while the cattle were exposed in a small pen and forced to be in a cloud of dried tuberculous matter for an hour on each of two successive days and were also fed hay thoroughly mixed with the dried tuberculous material.

In water holes, on the other hand, we find 687 days after exposure in one experiment and 548 days after exposure in a second, that the tuberculous material is still capable of producing turberculosis in guinea pigs when inoculated. The end point in first experiment was apparently reached.

In the case of exposure of tuberculous material when kept moist as in a water hole, it was deemed necessary to determine to what extent the cattle would become infected when exposed to such material. We found that all of three cattle became tuberculous when forced to drink water taken from water holes ninety-eight days after such holes were infected with tuberculous material. The end point in this experiment was not yet reached. All of six cattle exposed earlier in the experiment also became infected.

The practical significance of these findings is very evident, namely:

Environs contaminated with tuberculous discharges from cattle become free from such infective materials soon after the media in which they are contained are freed from sensible moisture. On the other hand, tubercle bacilli that are found in water holes, mud holes and watering troughs retain their virulence for a considerable length of time.

Chemical Influence on Tubercle Bacilli of Hypochlorite Solutions.—The disinfection of premises following the removal of tuberculous animals has been generally recommended and practised. The value of such procedure is somewhat difficult to estimate from the evidence now in hand. To be of value a disinfectant must have the power to overcome the physical and chemical influences which it encounters when brought in contact with the media in which tubercle bacilli are naturally found. Practically all live stock sanitarians recognize the probabilities of not satisfying these requirements, and they, therefore, include in their directions distinct reference to the mechanical removal of infective materials by cleaning, scraping, etc.

Hypochlorite solutions have recently received considerable notice and large quantities are being sold to dairymen under various proprietary names.

Two series of experiments have been conducted exposing very thin films of tuberculous lung materials for from 1 minute to 22 hours to the action of solutions containing .5% to .3% available chlorine. From our results, it is impossible to draw definite conclusions as to the effect of chlorine solution on tubercle bacilli contained in tuberculous discharges from cattle. It is not surprising to find some unlooked-for results in such experiments, but some of the results are, nevertheless, difficult to explain. It was hoped to be able to plot out a curve from the results of the experiments made that would indicate the concentration of chlorine solutions and time of exposure that would kill tubercle bacilli. The results obtained, however, did not permit the establishment of such curve. The variables which are ever present in the practical disinfection of cattle environs were here also important factors in bringing forth uneven results. Among these are (1) the amount of tuberculous material (in our experiments this was crudely estimated); (2) the complex composition of the tuberculous material; (3) the affinity of chlorine for the tuberculous material, and (4) the affinity of chlorine for the objects carrying the tuberculous material.

In a general way the results indicate (1) that chlorine solutions do not kill tubercle bacilli momentarily in naturally infected discharges; (2) that chlorine solutions are capable of destroying tubercle bacilli under certain conditions; such favorable conditions were not determined by these experiments: (3) that tubercle bacilli were at times not destroyed when subjected to more severe exposure than given in practical disinfection; (4) that in our work the less concentrated solutions proved more effective.

To emphasize the mechanical removal of infection for the good it does and to sanction the use of disinfectants on general principles is a safe and sane stand to take on disinfection in the control of tuberculosis, in the light of our present knowledge.

Chicken-pox (Epithelioma Contagiosum).—Losses from this disease have been greatly reduced by the use of a vaccine distributed by this station. The preparation and use of this are described by Beach in circular No. 145 of this station. One injection will usually produce sufficient immunity to protect fowls against natural infection for a year. The immunity does not reach its full development until three to six weeks after vaccination. Experience in the field has shown that occasionally a second injection is necessary to stop the spread of the disease. The vaccine appears to have considerable therapeutic value when administered to infected fowls. When properly administered, it is harmless to healthy fowls. It does not retard the development of growing fowls, nor directly decrease the egg production of laying hens. It has been found that the immunizing value of the vaccine varies in direct proportion to the virulence of the virus contained therein. It has not yet been possible to perfect a vaccine which will always produce absolute immunity against severe artificial infection.

In inoculating Leghorn cockerels for the production of chicken-pox virus used in the preparation of vaccine, the amount of dried scabs produced per bird was about 4 grams. The mortality of the birds used was over 50 per cent. The amount of scabs produced per bird was greater and the percentage of mortality less during warm weather or when the birds were kept in a warm room. Pox of turkey was found to be transmissible to chickens and chicken-pox to turkeys.

Sour-Milk Treatment for Poultry Diseases.—In confirmation of observations at other stations, it has been found that coccidiosis in chicks and entero-hepatitis in turkeys appear to be beneficially influenced by a sour-milk diet. Observations covering a period of three years show that these diseases have been promptly checked and birds successfully matured in infected yards when fed liberal amounts of sour milk with a restricted grain and mash ration. Further work should, however, be done to establish the value of this mode of treatment with certainty.

Bacillary White Diarrhoea.—To determine the efficiency of the "Intradermal Test" for the detection of *Bact. Pullorum* infection in mature fowls, 140 birds were subjected to both this test and the "Agglutination Test." The results indicated that the Intradermal Test is not reliable.

One outbreak of a rapidly fatal disease of mature fowls which caused a loss of more than 25% of the flock was found to be due to *Bact. Pullorum* infection.

Avian Tuberculosis Detected by Intradermal Test.—This disease has been found in flocks in several different sections of the state. The results of an investigation of the "Intradermal Tuberculin Test" would seem to confirm the work of Van Ness that this is a fairly reliable means of detecting tuberculosis infection in fowls.

Fowl Cholera in Turkeys Not Controlled by "Bacterins."—In turkeys, the results of an investigation of the value of autogenous bacterins in control of the disease seem to indicate that the bacterins have neither curative nor immunizing value.

Intestinal Round Worms Expelled by Tobacco Dust.—Investigations in cooperation with Dougherty in the control of round worms has shown that "tobacco dust" added to dry mash in the proportion of 1 lb. tobacco to 50 pounds mash and fed daily for two or three weeks is an effective means of expelling these parasites. Good results were also obtained with tobacco dust given in a single dose in dry mash, using 1 pound for each 100 birds. The results of investigations not yet completed, of the efficiency of tobacco dust for preventing round-worm infestation and the effect on growth of chicks, if fed daily or intermittently from the age of 30, 50 or 70 days to maturity, seem to indicate that it can be safely fed daily in the proportion of 1 pound of tobacco to 50 pounds of mash from the time the chicks are 70 days old and for periods of 20 days, with an interval of 20 or 30 days between during which no tobacco is fed. Since neither the treated nor check pens have thus far become badly infested with round worms, no information regarding the efficiency of this method of preventing round-worm infestation has been obtained. Oil of chenopodium (American wormseed) proved effective for expelling round worms. The amount used was 1 teaspoonful for each 12 birds, mixed with moist mash. As a single-dose method of treatment this seemed to be more desirable than tobacco dust. The results of preliminary trials with the leaves of plants from which oil of chenopodium is derived indicated that they might be an effective vermifuge for poultry.

Blackleg Culture Filtrate Gives Short Immunity.—The idea that one vaccination with blackleg-culture filtrate would confer life immunity has become quite prevalent among livestock owners in some localities as a result of intimations made by some biological firms. Field trials were made by Hart with the young cattle in the University Dairy on the Berkeley Campus, which showed that this material will not confer life immunity in animals vaccinated under 6 months of age. In many parts of California, vaccination under the age of 6 months is necesary to prevent losses.

There was a total of 14 animals in the culture-filtrate experiment and 2, or 14%, developed the disease after one vaccination. Most of the animals were over 6 months of age. One calf, No 2062, born December 22, 1917, and vaccinated January 23, 1918, developed blackleg May 28, 1919, but recovered after large doses of blackleg serum were administered. Another calf, No. 2064, born September 7, and vaccinated the latter part of December, 1918, died of the disease April 18, 1919.

It is, therefore, recommended that where this material is used, all animals of susceptible age be vaccinated twice yearly, the same as has been the general practice with the old muscle vaccine.

Cocoon Silk of the Tent Caterpillar Not a Food for Hogs.—In June, 1918, Hayes was called to investigate a disease in hogs in Round Valley, Mendocino County, which was reported as hog cholera, and for which a large quantity of anti-hog-cholera serum had been ordered. Several herds were affected with the disease. The most prominent symptom observed was the defecation of long ropes of feces. This effort caused severe straining which resulted, in many cases, in leaving a foot or more of feces still attached to the hog. All the hogs were gaunt, but had some appetite. Autopsies on several hogs showed an undigested mass in one continuous connected string from the stomach to the anus. Twists of the bowel and inflammation were present in one case which was killed in a moribund state. The intestinal mass was made up of a wool-like fibre, enmeshing bits of grass, barley and fragments of a dark brown material. It was evident that a feed condition was responsible for the trouble and this was sought and found to be the cocoons of the tent caterpillar *(Malacosoma disstria).* On the hillsides of the range hundreds of cocoons were found attached to plants and on the leaves of oak trees. The wool-like fibres of the intestinal mass were identical with the silk of the cocoon and the dark brown fragments proved to be pupae. A handful of the pupae enclosed in their silk were eagerly eaten by the hogs. Treatment consisted in keeping the hogs off this range until the pupae emerged. Most of the hogs then recovered. No hog cholera serum was necessary.

Results of Hog Cholera Immunity Experiments.—One thousand garbage-fed pigs, aged 6 to 7 months, which had been vaccinated just after weaning time by injecting simultaneously 2 to 3 c.c. of virus and the recommended dose of serum, were subjected by Petersen to severe infection by injecting them with large amounts of virus. Nine hundred eighty-five were *absolutely* immune.

Fifteen thousand garbage-fed pigs, all the offspring of immune sows, were vaccinated just after weaning as above described and were observed until sent to market. No losses occurred from hog cholera, although unvaccinated check pigs under the same conditions contracted cholera.

Improvement of Stock Made Possible through Immunization.—On account of the greater susceptibility of the better type of hogs to cholera, the improvement of garbage-fed strains by the use of pure-bred boars was impracticable until anti-hog-cholera serum was discovered. The feeder has always been forced to breed and raise his own stock or, if he purchased new stock, it came from another garbage plant. Several years ago hogs that were fed garbage were usually of a type resembling wild hogs. They were small animals, long-nosed, thin-boned and lean. Through years of selection of sows that gave birth to the largest litters and raised their pigs the best, a kind of hog has been produced that has been termed a garbage-type. These hogs, being developed under conditions of limited movement, are slow growing, but produce large litters and are good milk producers. Comparing this type of sow with pure-bred sows, we find that they are more prolific, raise their pigs better and take less feed than do the pure-breds. Observations at large garbage feeding plants show that crossing a garbage-type sow with a pure-bred boar gives as large a litter and a better growing pig, so that crossing garbage sows with pure-bred boars gives better hogs for garbage feeding.

Improvement in the Quality of Anti-Hog-Cholera Serum.—The presence of red blood cells in ordinary anti-hog-cholera serum is objectionable because they are not absorbed quickly from the point where the serum is injected and because they have no immunizing properties. A cell-free serum is also desirable because it can be pasteurized and rendered free from contaminating pathogenic organisms, while the pasteurization of serum containing large numbers of red blood corpuscles causes coagulation.

After six years of experimenting with various kinds of centrifuges, a machine has been found which will clear the serum in a satisfactory and economical manner. This is called a vertical, direct-connected, bucket-type centrifuge. The motor is 10 horsepower and gives a speed of 3,600 revolutions per minute to four steel cups having a capacity of 800 cc. each. The precipitating force is 3,000 lbs. Full speed for ten minutes will thrown down the red cells and other debris in the form of a clot, leaving the serum a semi-transparent pink fluid.

The reduction in the bulk of serum, due to the removal of the red corpuscles varies from 74 to 86 per cent, but since laboratory tests have shown this product to be more potent than the ordinary defibrinated blood, the inspectors of the United States Bureau of Animal Industry permit the loss in volume, due to centrifuging, to be replaced by the addition of physiological salt solution containing ½% phenol.

Diseases of Sheep.—The increase in the number of inquiries concerning diseases of sheep received recently by this station can be attributed to two causes, i.e.,

(1) The rise in value of these animals which is causing owners to take more precautions against loss; and (2) the increase in the number of flocks in the state kept on small farms.

In the latter case the animals are confined in fields during the entire year and usually receive more abundant feed and less exercise than range sheep. These conditions predispose to preparturient paralysis and similar diseases.

Preparturient Paralysis of Ewes.—Has been investigated by veterinarians of this Station. It attacks fat ewes several days before due to lamb. The cause of the disease has not been definitely determined, but lack of exercise and over-feeding of animals in such condition are no doubt primarily responsible for the trouble. The affected ewes are dull, listless and aimless in their movements. In advanced stages, there is loss of vision, staggering gait or inability to rise. After five to eight days of illness, the animal usually dies.

Prevention has been successful and consists in avoiding conditions that make for the excessive deposition of fat. This can be done by limiting the amount of dry feed given to ewes during the last month of pregnancy and making them rustle for their feed to give them plenty of exercise. Grazing in pastures containing green feed for one or two hours a day will have the effect of giving them succulent food and exercise at the same time*

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* A mimeographed circular on this disease by Traum may be obtained on application.

The ill effects of heavy feeding and lack of exercise are not always confined to the ewes. When sheep in fat condition begin to die, it is usually advisable to move the animals and to change and reduce the feed.

Genito-Urinary Infection in Sheep.—An affection of bucks was investigated which manifests itself chiefly by marked enlargement of one or both testicles and is termed "Big Ball," by the sheep men. A number of cases were examined by Hart and postmortem examinations held which showed that the testicles were not the only parts affected in all cases. Marked changes were found in the kidneys, bladder, prostate glands, urethra and penis. The infection progresses to the point of pus formation and necrosis of soft tissues. In some cases the entire testicle is destroyed. Cultures made from the affected areas on blood agar developed an organism which proved to be *Bacillus pyogenes.* This organism when injected into the testicle of a healthy buck produced a slowly-progressing inflammation accompanied by pus formation similar to the naturally infected cases.

A number of fatalities occurred from the disease, but its most serious aspect was the fact that a band of these bucks, which had either not been visibly affected or had apparently recovered, when bred to ewes, produced a very low percentage lamb crop, amounting to about 33⅓%. The mode of infection has not been definitely determined, but some evidence was found to show it had occurred through the urethra. The bucks were being kept on very good green feed and in a large band of several hundred head corraled each night. They were practicing sodomy upon each other to a marked degree, and it was from this source that the infection most likely originated.

Treatment of affected animals is unsatisfactory, castration in some cases being indicated.

Prophylaxis would consist in keeping the animals on less stimulating feed without crowding them together at night in corrals, or in dividing them up into much smaller bands.

Necrobacillosis in Lambs.—Two serious outbreaks of necrophorous infection (*necrobacillosis*) in baby lambs were investigated. The disease in this form is somewhat unusual and, in the two flocks mentioned, caused the lambing percentage to drop to about 75 per cent. Lambs are predisposed to this organism through being born in unsanitary lambing sheds or in muddy pastures. Infection presumably entered through the navel and caused death in these cases in from 24 to 72 hours after birth. The most evident lesion appeared in the liver and was characterized by the formation of multiple necrotic areas of a grayish-yellow color, varying in size from a match head to a pea. The necrophorous organism appeared in smears stained from the border of the necrotic areas. Some cases also showed gastric infection. Cleaner lambing quarters, with disinfection of the navel at birth with iodine, were recommended and resulted in an appreciable cessation of deaths.

Hemorrhagic Septicaemia in Sheep.—Field investigations of diseases in sheep, together with specimens and letters received, indicate that this disease is much more prevalent than has been commonly supposed. It is characterized by occurring sporadically and with a variable mortality in different flocks. It occurs in both an acute and a chronic form. In the acute form, there is high temperature, loss of appetite, shivering, prostration and early death. The lesions are those of a general septicaemia, with small hemorrhages in the subcutaneous tissue of the anterior part of the body and also in the various organs, particularly lymph glands, heart and lungs. In the subacute or chronic form, the symptoms are milder with little elevation of temperature. Discharges from symptoms are milder with little elevation of temperature. Discharges from the eyes and nose, weakness, lameness, pneumonia, pleurisy and emaciation are common symptoms. Three outbreaks have been investigated by the Veterinary Division during the year. In two of these, a vaccine made from the causative organism (*B. ovisepticus*) and administered subcutaneously gave excellent results. In one herd of 300, out of which 15 head had died over a period of three weeks, no further losses were sustained at 4 weeks. The infection has apparently cleared in another flock of 100 head since vaccination. The relation of *B. ovisepticus* to some of our sheep diseases needs further investigation.

FARM BUILDINGS AND TOOLS

Farm Buildings.—The method of procedure by the Division of Agricultural Engineering has been to determine good practice in buildings, incorporate this practice into plans and through coöperation with builders, use the plans so prepared as the basis for development and improvement. It is clear to those identified with the work that the greatest opportunity for service lies in putting into the definite form of plans what is recognized as best practice. It is not possible for obvious reasons for the individual builder to do this, at least thoroughly.

All of the investigational work in farm buildings has been carried on in coöperation with other Divisions interested,—for the most part with the Division of Animal Husbandry.

The war cut off to a great extent building operations on the farm and elsewhere, especially during the year 1918, but indications now point to renewed interest and activity in this connection.

Dairy Buldings.—The results of the study of dairy buildings have been incorporated into three plans of milking barns and one plan of a milk house. The plans of the milking barns have been distributed in rather large numbers, 172 sets of plans being furnished during the past year. The plans have been inspected and approved by the San Francisco Board of Health. An experimental milk house has been designed and built at Davis, and is now undergoing study. The significant features of the house are a smooth washable interior, well insulated walls of tile, and ceiling insulated with sil-o-cel.

Lambing Sheds.—Fermery and Miller made a careful study of lambing sheds and reported best practice in Circular No. 188. An investigation revealed that the use of the buildings described would be an important factor in reducing mortality among new-born lambs.

Silo Construction.—At the request of the Division of Agricultural Extension, a cheap, home-made silo was designed by Davidson. This silo, although perhaps not the best type, meets all of the essential requirements of a good silo and can be erected at a low cost. It is estimated that over 300 were built in the state in 1918.

Hog Houses.—The plans resulting from a study of hog-house construction have been distributed in larger numbers than any other plan,—318 plans having been distributed during the past year. Many of the new houses are undergoing study by the staff and their owners.

Beef Cattle Barns.—A simple plan for a beef cattle feeding barn has been prepared by Davidson which incorporates a convenient arrangement for the handling of the feed and stock. This plan is now being used as a basis for further study.

Distribution of Plans.—The following list of plans have been prepared by the Division of Agricultural Engineering and are available for distribution, of which 1971 sets have been distributed during the present fiscal year:

B–1–2	Beef Barn for Feeding Hay.
B–14–2	Self-Feeder for Swine (Style 1).
C–15–1	Moveable Hog House.
B–18–1	Portable Sheep Manger.
B–19–2	Self-Feeder for Swine (Style 2).
C–22–1	Community Hog House (Iowa Type).
C–23–2	Small General Purpose Barn.
C–28–4	Standard California Type Dairy Barn.
C–29–1	Hay Storage Barn.
C–30–1	Detail showing construction Bent Rafter Dairy Barn.
B–31–1	Septic Tank for Ten People.
C–33–2	Farm Implement Shed.
C–35–2	Monolithic Concrete Silo.
B–36–4	Small Milk House.
B–37–1	Modified Feed Rack for Sheep.
B–38–2	Hay Rack for Cattle.
B–39–1	Feed Rack for Sheep No. 2.
A–40–1	Lambing Hurdle.
A–41–1	Diagram Sheep Dipping Vat.
A–42–2	Bunk House, Sketches.
B–44–2	Ford Power Attachment.
B–46–1	Lock for Barns and Box Stalls.
B–47–2	Hoof Trimming Crate for Swine.
C–48–2	Work Stock Barn for 16 Head.
C–49–2	Work Stock Barn, 1-story type.
C–50–4	Standard Milking Barn for 120 Cows.
B–51–6	16 × 20 Poultry House, Shed Roof Type.
B–54–4	Small Milking Barn for 10 Cows.
B–56–1	Portable Fence Panel for Hog or Sheep.
B–57–4	5 × 6 Knock-Down Poultry House.
B–58–2	Dipping Vat for Hogs.
C–60–1	Parting Chute for Cattle (after T. S. Glide).
B–62–1	Parting Chute for Sheep.
B–63–2	Continuous Lambing Jails, Sheltered with Panel Roof.
C–72–2	Four-Room Bunk House No. 1.

B–77–1	Stock-yard gate with latch that can be operated from horse-back.
B–78–1	Breeding Stall for Dairy Cattle.
C–79–1	Seed House for Grain Sorghums.
C–80–4	Milk House for University Farm.
C–81–1	Breeding Rack for Swine.
C–82–1	Frame Water Tower for 5000-gallon Tank.
B–84–1	Shipping Crate for Swine.
B–87–1	Bean Cutter—Sled Type.
B–88–1	Silage Bunk or Manger for Beef Stock.
B–89–1	Device for placing and removing wagon racks.
B–93–1	Corn Cutter—Sled Type.
B–94–1	Concrete Vat for Cooling Milk.
B–98–1	Alfalfa Feeder for Swine.

Spark Arresters.—At the request of the committee on fire protection, the division has tested the usual forms of spark arresters for tractors. The centrifugal type was found to be much efficient than any of the screen type of arresters. The annual loss of grain from fires traced to tractors makes the use of an efficient spark arrester most important.

Fire Extinguishers.—At the request of the committee on fire protection, tests are being made of the ability of standard fire extinguishers to withstand the jar of tractors and field machinery. After being carried on a tractor for 100 hours in the field, no deterioration in effectiveness of charge was noted in any of the four types of acid bottle extinguishers fitted with heavy lead acid bottle stoppers of the regular design.

Preservative Treatment of Wood in Silos.—Tests conducted to determine the relative merit of several standard and commercial wood preservatives indicate that heavy creosote oil is as satisfactory as others and cheaper. Heavy coal tar, however, seals all cracks in the silo when properly applied.

Tractive Resistance of Farm Wagons on Different Road Surfaces.—Tests have been made by the Division upon the request of the California State Automobile Association to determine the tractive resistance of a wagon on the different types of roads in use in the state. A standard farm wagon was used, equipped with wheels 38 and 46 inches in diameter and four-inch tires. An average speed was maintained of about 2.4 miles per hour. A summary of the results is as follows:

	Pull in Pounds per Ton
Over a level, unsurfaced concrete road	27.6
Concrete base, ⅜-inch skin top asphaltic oil and screenings	49.2 51.6
Water-bound macadam, level, good condition	64.3
Concrete base, 1½-inch Topeka top, level, good condition	68.5

	Pull in Pounds per Ton
Gravel road, good condition, level	78.2 81.3
Earth Road, fine dust, level	92 99.3
Earth road, stiff mud on top, firm underneath, level	218
Loose gravel, not packed down, new road, level	263

ACTIVITIES

Aside from conducting research work the Department of Agriculture is charged with a great variety of responsibilities and duties, which may be conveniently classified into instruction and extension. The constant and legitimate demands upon the department for public service, that is, for work outside the institution itself, are most varied and time-consuming. During the period of the war, probably the equivalent of two-thirds of the time of the staff has been employed in such activities. Since an account of the war activities of the university has been already published elsewhere,* only incidental reference will be made to such activities in this report.

Probably the two most important developments of the year have been the large expansion of the extension activities of the department throughout the state and the emergency courses of study offered at the University Farm. The character, amount and purpose of the extension activities have been outlined at some length in circular No. 208 and Circular No. 209, while a brief summary will be found on page 101. All that need be said here is that this phase of the work has become an established and integral part of the work of the College of Agriculture, employing the whole time of some seventy-five members of the staff and during the past two years it has occupied a part of the time of practically all the other members of the department. The Farm Bureaus of the state now have a membership of some 22,000, and over 400 meetings are held each month in as many different Farm Bureau centers.

A teacher training center for students planning to engage in high-school agriculture work has been established at Davis at the request of the California State Board of Education. To date, 102 so-called emergency students, the majority of whom have had no agricultural college training, have received instruction, both in technical agriculture and in teaching principles and methods. Perhaps the most striking feature of the instruction has been the project work, developed to a rather high degree of perfection at the University Farm. The requirement of the State Board of Education that all high-school students benefiting by the Smith-Hughes fund should conduct a project involving the raising of animals or the production of some crop necessitates the training of teachers to supervise these projects. It gave immediate impetus to the development of teaching by means of projects at the University Farm, a small beginning having already been made by the Olericulture Division. Thirty-five projects have been started. The plan involves a definite investment by the student, as in the case of the purchase of animals or appliances or in the case of lease of land, and that the student shall make a deposit which will be refunded at the conclusion of the project or forfeited if the student fails to perform his part of the work. The division of the proceeds varies according to the character of the responsibility of the students in the several projects. The proprietary interest of the student in these projects has resulted in the most gratifying enthusiasm in the work. generally speaking, the aim is to make the project large enough to teach the lessons involved, but not so large that the prospective financial reward would make the student feel he must sacrifice his other duties in order to insure the financial success of his project.

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* Universiy of California War Service Record for the Academic Year 1917–1918. Univ. Calif. Chronicle, Vol. XX, No. 3, pp. 295–442.

Beginning June 30, 1919, as a part of the University of California Summer Session, twenty-three teacher training courses in agriculture are being offered at the University Farm, and certain courses will be offered at the Citrus Experiment Station. As heretofore, courses in agriculture are also offered at the Summer Session at Berkeley and at Los Angeles.

In response to the request of the Federal Board for Vocational Education, Rehabilitation Division, men injured in the National Service and entitled to reeducation to increase their earning power have been admited to various courses in the College of Agriculture at Berkeley and in the Farm School at Davis, at the beginning of the second semester. Beginning June 9, 1919, and extending to September 27, 1919, special short courses are conducted with an attendance of over 100 "rehabilitation" men. The Federal Vocational Board has also designated the University Farm as a receiving station for compensable soldiers during the period of their classification and assignment to courses of study.

One of the most significant activities of the State of California with which the department is directly and indirectly connected is land settlement, which had its first concrete development in California in the State Land Settlement Colony at Durham. The successful beginning made there, as well as the nationwide interest in it, has led the Legislature to provide an appropriation of $1,000,000 and to provide for an initiative vote on a bond issue for $10,000,000. These appropriations will be in the nature of a revolving fund, since the money is to be paid back with interest.

Mead has continued to serve as Chairman of the State Land Settlement Board. He has been in frequent consultation with the Secretary of the Interior concerning the national program for the so-called Soldier and Sailor Settlement Act and has had much to do with popularizing and shaping legislation on land settlement. For further account, see page 106.

An important addition to the personnel of the staff was made during the year by the appointment of J. C. Whitten, formerly Professor of Horticulture, University of Missouri, as Head of the Division of Pomology.

During three months, October, 1918, to January, 1919, Lipman acted as technical advisor to the Secretary of Agriculture relative to the war control of the fertilizer industry.

The Division of Farm Management has been created with R. L. Adams as professor in charge. On invitation of the Secretary of Agriculture, Adams was chairman of the committee which recommended a plan of reorganization of the Office of Farm Management, United States Department of Agriculture. Four months were given to this responsible duty.

F. L. Griffin, formerly Professor of Rural Education, Cornell University, has been added to the Division of Agricultural Education as associate professor and, in the absence of Hummel with the Federal Vocational Educational Board at Washington, D. C., has been acting head of the division.

Herms and Freeborn, recently released from the Sanitary Division of the Army, continue coöperation with the State Board of Health in mosquito abatement.

Jaffa continues to pass upon the purchase of food supplies for the State Board of Control and to supervise the dietaries of the inmates of the eleemosynary institutions of the state. His testimony before the National War Labor Board in Washington, D. C., and before the Board of Arbitration, Oakland Railway System, on "The Living Wage" was far-reaching.

Essig has been absent on leave since April 1st, as manager of Lima Bean Selling Agency, organized in Ventura County to standardize and dispose of the lima beans of that territory. Within two months, approximately thirty million pounds of beans were sold.

Soon after returning from the Army, Mason was requested to become Forest Valuation Expert for the United States Treasury Department, and is absent on leave for that purpose.

From August to January, R. L. Adams and T. R. Kelley maintained an office in the rooms of the State Council of Defense in the capacity of state labor specialists for the United States Department of Agriculture. The former acted also as Secretary of the Committee on National Resources and Food Supply of the State Council of Defense, which committee held meetings weekly during the period of greatest stress.

Woodworth returned in January from his sabbatical leave at the University of Nanking, China.

Gericke has spent his sabbatical leave studying under Livingston at Johns Hopkins.

Baird spent the first half of his sabbatical leave in the study of market conditions concerning dairy products in the United States Department of Agriculture, and the last half in study at the University of Wisconsin.

Hendrickson has exchanged with Overholser of Cornell as Instructor in Horticulture.

The following persons have returned from military service:

C. M. Haring, Professor of Veterinary Science.

D. T. Mason, Professor of Forestry.

W. B. Herms, Associate Professor of Parasitology.

S. H. Beckett, Assistant Professor of Irrigation Investigations.

Donald Bruce, Assistant Professor of Forestry.

R. E. Clausen, Assistant Professor of Genetics.

Stanley B. Freeborn, Assistant Professor of Entomology.

G. R. Stewart, Assistant Professor of Agricultural Chemistry.

E. C. Voorhies, Assistant Professor of Animal Husbandry.

A. W. Christie, Instructor in Agricultural Chemistry.

Clarence V. Castle, Assistant in Animal Husbandry.

H. A. Wadsworth, Assistant in Irrigation Investigations.

H. E. Drobish, J. P. Hertel, R. D. McCallum, A. N. Nathan, W. D. Norton and C. E. Sullivan, Assistants in Agricultural Extension.

Frank Adams, Professor of Irrigation Investigations; E. B. Babcock, Professor of Genetics, and Walter E. Packard, Assistant Professor of Agricultural Extension, are absent on leave, lecturing in France on agriculture in connection with the educational work of the Y. M. C. A. since taken over by the United States Army.

R. S. Vaile, Assistant Professor of Orchard Management in the Citrus Experiment Station, has returned from a mission to Persia.

Several members of the staff are still in military service, while still others, although discharged, have resigned to enter other agricultural fields.

Hereafter, the police powers in connection with the Fertilizer Control Act and the Insecticide Act, which have been in charge of the Director of the Agricultural Experiment Station, will be transferred to the newly created office of the State Director of Agriculture. This department is not only charged with the analysis of fertilizers and insecticides, the production and distribution of anti-hog-cholera serum and virus, chicken pox vaccine, certified milk inspection for San Francisco and Alameda County Milk Commissions, for which services it is reimbursed, but it performs a considerable service free in the examination of numerous samples of irrigation waters, soils, foods, and plants. No comprehensive summary can be made covering these activities, but the following statements will illustrate some of them.

During the past three years the Nutrition Division has made upwards of 1500 analyses of foods and food products used by man and other animals. These analyses were necessary to answer intelligently correspondence queries. During the year, 2000 soil samples have been examined and 1414 letters written by the Division of Soil Chemistry and Bacteriology in answering inquiries. During the year ending March 31, 1919, 1077 inquiries by stock owners and veterinarians concerning diseases of animals have been answered by letter or interview and the reports on 86 animals or specimens have been made by the Division of Veterinary Medicine. In addition, numerous trips were made to various points in the state in response to urgent requests. The Division of Dairy Industry analyzed 163 samples of cream, 115 of butter and 23 of cheese. Commercial scores were placed upon 69 samples of butter forwarded to the division during the year. Marquardt supervised for the United States Navy the manufacture of 159,273 pounds of butter in California. Three educational butter and cheese scoring contests were held in different sections of the state during the past year, namely, at Los Angeles Creamery, Tulare, August 9th, at the University Farm during the buttermakers short course, November 21st, and at the Gustine Creamery, Gustine, on April 3d. A program for practical creamerymen and buttermakers and competitive judging contests were held in conjunction with each scoring. The Division of Pomology has conducted 251 demonstrations in pruning and 30 in fruit packing, with a total attendance of 7200, not counting persons attending evening lectures. In coöperation with the State Board of Education, Griffin and Dadisman have visited during the year 87 high schools maintaining instruction in agriculture. Sixty-four designs of farm structures have been prepared by the Division of Agricultural Engineering, and during the year, 971 sets of blue-printed plans have been distributed. During the war emergency period, practically the entire effort of the Division of Irrigation Investigations was spent in coöperation with outside agencies, such as the United States Food Administration and the State Railroad Commission, in the endeavor to obtain the maximum utilization of the irrigation water supply in the production of food. In the Seed Laboratory 2963 samples of seed have been tested for purity and germination.

The various agricultural industries are being served through the connection of members of the staff with outside agencies. In coöperation with the Dairy Division of the United States Department of Agriculture, the Child's Bureau of the United States Food Administration and the Indian Bureau of the United States Department of the Interior, Van Norman worked out plans for the educational exhibit of the National Dairy Show held at Columbus, Ohio, in October, 1918. In addition to acting as Chairman for the Livestock Commission for the Federal Food administration for California, True gave much of his time during the year as a Director of the California Cattlemen's Association. Thompson has served continuously as Secretary-Treasurer of the California Swine Breeders' Association since its origin in April, 1913, except for one year while absent from the state. Miller held the same position with reference to the California Sheep and Wool Growers until his resignation from this institution January 1, 1919. Webber was elected President of the Citrus Institute organized and held in connection with the Orange Show at San Bernardino. For two years he was President of the California Avocado Association.

Over 7000 tests of about 1500 pure-bred dairy cows owned by 103 different breeders have been made under the direction of Woll during the year. For eight years, the department, through its Division of Veterinary Medicine, has been investigating and distributing cholera serum, during which time, 10,612,840 c.c. have been sold and used to treat approximately 388,770 hogs. Private firms have now become fully able to supply this serum, which is made under the inspection and control of the United States Department of Agriculture. During the year, 231,078 doses of chicken pox vaccine were distributed to poultry raisers. Including the work done for the San Francisco and Alameda County Medical Milk Commissions, 3213 head of cattle have been tested for tuberculosis.

A survey of the soils of California is being carried on by the Division of Soil Technology in coöperation with the United States Department of Agriculture. Since 1916, 18,350 square miles have been surveyed. Reconnaisance surveys have been completed covering the Middle San Joaquin Valley Area and Upper San Joaquin Valley Area and the Central Southern California Area. Detailed surveys have been completed covering the El Centro, Grass Valley, Santa Maria, Ventura and Willits Areas. To date, reconnaisance or detailed surveys have been made covering about 25% of the total area of the state, probably about 60% of the land in farms.

Upon the request of the State Council of Defense, a committee of the Department of Agriculture, with Van Norman as chairman, prepared for Governor Stephens a series of recommendations on reconstruction. (See Appendix to this Report.)

Numerous meetings of breeders' associations and stockmen have been held at the University Farm. Auction sales were also held there by the California Shorthorn Breeders' Association, Pacific Coast Hereford Cattle Breeders' Association and the Western Berkshire Congress. At the Shorthorn sale, a yearling shorthorn bull, California Model, full brother to California Marvel, sold for $5500 to the Conway Ranch, Woodland, thus establishing a record price for a bull bred by an agricultural college, as well as for a beef animal on the Pacific Coast.

The lease in 1917 for a period of ten years of 300 acres of land adjoining the University Farm, Davis, makes available nearly 100 acres for the work of that institution. It has added notably to the field crop investigations, 90 acres having been assigned to the Division of Agronomy for this purpose.

The Citrus Experiment Farm, Riverside, containing about 300 acres of tillable land, came into the posession of the University in 1916. A citrus grove of 70 acres, intended for fertilizer, cultivation, pruning and irrigation experiments, was planted in 1917. A citrus variety orchard of about 500 different varieties and forms has been planted. About 100 seedling avocados and several hundred seedling guavas are being grown for the purpose of selecting improved varieties. About 130 hybrid peach trees, grown from hybrids made by Babcock, have been planted.

Aside from the students in the Students' Army Training Corps, during the first semester of 1918–19 there were only a few university students in Agriculture. During the second semester, the total enrollment of university students had risen to 397. In addition to the university students, 163 students were enrolled at the University Farm School, 298 in farmers short courses, and 76 in short courses for rehabilitation soldiers. Four four-day special poultry institutes were held by the Division of Poultry Husbandry at San Gabriel, May 26th to 29th, and at San Diego, June 3d to 6th, 1919, with about 275 persons in attendance at each. In addition to the beekeepers short course held at the University Farm, Davis, December 2d to 7th, similar short courses were held at Visalia, December 9th to 14th, and at San Diego, November 25th to 30th. The beekeeping course announced for Riverside had to be abandoned on account of influenza.

The number of correspondence students in agriculture in common with resident students has been less than in former years. Nevertheless, 1448 students have completed 1760 courses during the year. The total number of students enrolled in correspondence courses in agriculture since the beginning of this instruction is 16,878. There are 27 correspondence courses in agriculture which have been completed during the year, the most popular ones in point of number taken being poultry husbandry, swine husbandry, vegetable gardening and alfalfa culture, in the order given. Instruction in agriculture at San Quentin has been interrupted by the influenza and other circumstances. Ten lectures were given by members of the staff with an average attendance of 225 persons. Many calls for lectures come to members of the staff in addition to the normal extension work. Kern has, for example, during the year given 42 lectures, attended by more than 8000 people. Since October 1, 1913, he has given 622 lectures and in that time has addressed more than 115,000 persons, largely upon school gardens and community schools.

Extension Service.—The Extension Division of the College of Agriculture attempts to place before the people of California in an organized way the results of the research work of the College of Agriculture and the United States Department of Agriculture.

It has five major activities: (1) farm advisor work in organized counties, in coöperation with county farm bureaus, (2) home demonstration work in organized counties through the county farm bureaus, (3) agricultural club work through the county farm bureaus and the public schools of the state, (4) extension schools, demonstrations and personal visits in unorganized counties having no farm bureaus, (5) public service to inquirers at the College of Agriculture through calls, letters, telephones, etc. Each of these will be discussed separately.

Farm Advisor Work.—The report ending June 30th, 1917, noted that there were farm advisors at work in 17 counties of California. By June 30th, 1918, this number had increased to 33 counties and during the past year two others have been added, namely—Butte and Tehama Counties, thus making 35 counties in all in which farm advisors are employed. This large increase of the farm advisor work in California has been made possible by the War Emergency Appropriation of Congress for food production, for which the Secretary of Agriculture allotted $148,560 per year for California.

While in June, 1917, there were 5,321 members in county farm bureaus, this number had risen by December 1, 1918, to 19,803 and has probably since been increased to about 22,000 persons. There is perhaps no agricultural organization west of the Rocky Mountains comparable with it in size. These farm bureaus are now planning to combine into a California Farm Bureau Federation which has for its purpose the unifying of the counties upon a program of work, assisting the Extension Division in its activities, and making for the general agricultural improvement of the state.

Up to the end of the war, the farm advisors and farm bureaus were largely concerned in the furtherance of the emergency food production campaigns requested by the national government. Thus campaigns for the increase of pork production, building of silos and production of sorghums, protection of grain fields and grass ranges from fire, securing of better seeds, increase of mutton and wool production, and increase of wheat production were waged through these farm bureaus in the 475 farm bureau centers of the state in which they were active. The results of these campaigns, as well as the other work reported by the farm advisors for the period of December 1, 1917, to December 1, 1918, are given in full in Circular No. 208 of the Experiment Station, published in February, 1919.

It may be mentioned, however, that in addition to these campaigns during that period, the farm advisors were called upon to visit 15,216 different farmers on their farms, and held a total of 5,420 meetings, with a total attendance of 205,662. Despite the urgency of the war work, they located 1,420 field demonstrations on the farms of those men who desired to coöperate with them.

Home Demonstration Work.—At the beginning of the period of the war, the Extension Division had several extension specialists in home demonstration work who were itinerant about California. The Emergency Appropriation of Congress brought funds to intensify this work, the first development of which was to place district agents in the field over a number of counties. This proved its inadequacy due to the many demands made upon these agents so that a plan was inaugurated whereby resident county home demonstration agents were placed in counties upon the same basis as the regular system of farm advisors; that is, the farm bureaus formed a special department known as the farm home department wherein the women who lived on farms may coöperate in the improvement of home conditions. The board of supervisors of these counties appropriated $1,500 to pay the expenses of the agents whose salaries are paid and whose work is supervised by the College of Agriculture. Nine residents county home demonstration agents have been started during the past year in Shasta, San Joaquin, Alameda, Kern, San Bernardino, Los Angeles, Riverside, San Diego and Imperial Counties. During the war period, these agents were working upon four major projects, namely, . . . the canning and preservation of foods, the elimination of waste, the increase of home gardens, and the increase of farm poultry flocks. At the end of the war, their work was broadened to include problems of home management, dietetics, sanitation and others.

Agricultural Clubs.—During the period of the war, the number of district club leaders who are high-school instructors in agriculture, who coöperate in this work and who are partly paid to act as local agents in the agricultural club project were increased from 15 to 34 for the agricultural year ending December 1, 1918. During the present year, their number has been decreased to 22, but two county club leaders were also installed, being in Los Angeles and Fresno Counties. During the year 1918, there were 2750 boys and girls enrolled in these agricultural clubs which was a general increase of about 50% over the state. Their demonstration plots totaled 966 acres and they also raised 1855 pigs, 453 sheep, 28 calves and 3875 fowls. The valuation of the produce which they raised and for which they sent in definite and detailed records to the College was $67,321. For the year 1919, the work is now in progress for which no final figures are available.

Work in Unorganized Counties.—Extension schools of from one to three days' duration were held in Santa Clara, Lake, Inyo, San Benito, Trinity and Butte Counties with a total attendance of about 2500 persons; 150 field demonstrations were held in poultry husbandry, control of insect pests and plant diseases, pruning, care of forage crops, and animal husbandry problems. Personal visits were also made to a large number of farmers in these counties on request for information.

Public Service.—At the central office in Berkeley, 3120 calls were made by individuals for information; these were largely prospective settlers, including returned soldiers and sailors. During the past year 15,500 letters have been written in reply to direct requests for information on agricultural subjects; while there was a total of approximately 10,000 telephone calls requesting agricultural information, many of which were from city and suburban persons who were interested in gardening or similar problems as a result of the emergency calls by the government for an increased production of food.

Correspondence Courses in Agriculture.—Of the total number of students (36,878) 1448 have completed one or more courses since May 1, 1918, as follows:

1217	students have completed 1 course	(1217 courses completed)
172	students have completed 2 courses	(344 courses completed)
44	students have completed 3 courses	(132 courses completed)
11	students have completed 4 courses	(44 courses completed)
2	students have completed 5 courses	(10 courses completed)
1	student has completed 6 courses	(6 courses completed)
1	student has completed 7 courses	(7 courses completed)
1448		1760 courses this year.

The enrollment of new students during same period was 3029.

In the table below are listed the courses now ready and the number of students who have completed each course (May 1st, 1918, to May 1st, 1919).

Poultry Husbandry	278
Swine Husbandry	206
Vegetable Gardening	173
Alfalfa Culture	163
Home Floriculture	85
Milch Goat Raising	85
Dairy Husbandry	69
Sheep Husbandry	59
Plum and Prune Culture	58
Business Aspects of California Agriculture	53
Citrus Fruits	46
Fig Culture	46
Almond Culture	41
Corn Culture	41
Canning and Preserving	40
Adult and Child Nutrition (now called Normal Nutrition)	39
Walnut Culture	39
Onion Culture	35
Avocado Culture	32
Grape Growing	31
Olive Growing	27
Barley Culture	27

Lumber and Its Uses	26
Pear Culture	24
Bee-keeping	14
Semi-Tropical Fruits	12
Date Culture	11
	1760

Correspondence course students have been enrolled during the year from every county in California with the exception of Alpine and Sierra. Los Angeles County enrolled the largest number of students in the state during the year, namely 803. Alameda County is second with 252. Of the 48 enrolled from Marin County, 25 were enrolled from San Quentin Prison. Of the 49 enrolled from Sacramento County, 3 were enrolled from Represa (State Prison at Folsom).

Outside of the State, correspondence students have been enrolled from thirty-nine other states, as well as from the District of Columbia, Canal Zone, Hawaii, Philippine Islands, Canada, England, India, Japan, Mexico, New Zealand, South America, China, Australia, and Scotland.

During the year there were 93,738 pieces of mail sent out in the conduct of the Agricultural Correspondence Courses, inclusive of 594 copies of Circular 113. 26,056 lesson papers were corrected and returned, 33,092 new lessons were sent; 17,893 ''follow-up'' letters were mailed.

Vocational Teachers' Training Classes at the University Farm School.—To meet the demand for teachers competent to teach vocational agriculture in high schools where funds were provided under the Smith-Hughes Act, there was established at the request of the State Board of Education special short-course training classes in agriculture. The general plan of these courses was four hours per day daily for four consecutive weeks devoted to a particular subject. The first work began April 8th, 1918, and has continued throughout the year up to the courses ending June 30th, 1919. During the summer months of 1918, a total of 86 students were enrolled in these teacher training classes. During the school year, October 1st to and including the June period 28 different students have been enrolled in these teacher training classes. The requirement of the State Board of Education that all high-school students benefiting by the Smith-Hughes funds should conduct a project, involving the raising of animals or the production of some crop, necessitated the training of teachers to supervise these projects and gave immediate impetus to the development of teaching by means of projects at the University Farm, a small beginning having already been made by the Olericulture Division. Thirty-five projects have been started, of which seven have been brought to a successful conclusion. Twenty-eight are not yet complete; none have failed through remissness of the students.

The general plan involves some definite investment by the student as in the case of the purchase of animals or plants, or in the case of lease of land, the student shall make a small deposit of preferably $10, which will be refunded at the conclusion of the project or will be forfeited if the student fails to perform his part of the work. A contract has been drawn up indicating what the University Farm, as party of the first part, would furnish and on what terms; second, what part (usually the labor and in some cases the seed) the student, party of the second part, will furnish and what share of the proceeds each party would receive. The division of proceeds varies according to the character of responsibility of the student in the several projects. In some cases, the gross proceeds are divided equally; in other cases the student has received as high as 75% of the gross income; in a few cases as low as 40%. The students have shown the most gratifying interest in this work. They have been seen at work as late as nine o'clock at night and at various hours every day in the week. Generally speaking, the aim is to make the size of the project large enough to make it worth the student's while from an educational standpoint and large enough to teach the lessons involved, but not so large that the prospective financial reward would tempt the student to sacrifice his other duties in order to insure the financial success of his project. The variety and character of the projects are suggested by the following list:

	Date	Name	Project
	1918		
1.		V. F. Hall	Vegetable—Sweet Corn.
2.		Harry S. Thompson	Vegetable—Carrot seed.
3.	Oct. 22	Mrs. L. A. Paden	Vegetable—Cabbage.
4.	Oct. 22	W. A. Robbins	Vegetable—Cabbage.
	1919		
5.	Jan. 8	Geo. A. Barnett	Olericulture—Seed Onions.
6.	Jan. 8	Geo. A. Barnett	Olericulture—Market Onions.
7.	Jan. 8	Mrs. L. A. Lausten	Vegetable—Onion Seed.
8.	Jan. 8	Mrs. L. A. Lausten	Vegetable—Market Onions.
9.	Jan. 8	R. H. Hougham	Vegetable—Spring Onions.
10.	Jan. 8	Philander McHenry	Vegetable—Market Onions.
11.	Jan. 8	Philander McHenry	Vegetable—Seed Onions.
12.	Jan. 9	L. A. Lausten	Pure-bred sow and litter.
13.	Jan. 24	Elsie Gunn Collins	Vegetable—Onions.
14.	Jan. 24	V. F. Hall	Ornamental Plants—Roses.
15.	Jan. 24	Mrs. L. M. Paden	Ornamental Plants.
16.	Jan. 24	W. A. Robbins	Ornamental Plants.
17.	Jan. 25	L. A. Lausten	Ornamental Plants—Chrysanthemums.
18.	Jan. 28	E. B. Healton	Vegetable—L. A. Lettuce.
19.	Jan. 28	J. W. Johansen	Vegetable—Lettuce.
20.	Feb. 2	Elsie Gunn Collins	Duroc-Jersey sow and litter.
21.	Feb. 8	George A. Barnett	Rabbits—New Zealand Reds.
22.	Feb. 8	R. H. Hougham	Rabbits—New Zealand Reds.
23.	Feb. 10	E. B. Healton	Laying Hens—Caring for.
24.	Feb. 11	J. W. Johansen	Laying Hens—Caring for.
25.	Mar. 3	V. F. Hall	Hatching chicks.
26.	Mar 19	J. M. Bragg	½ acre potatoes.
27.	Mar. 19	R. H. Hougham	½ acre potatoes.
28.	Mar. 19	L. A. Lausten	½ acre potatoes.
29.	Mar. 12	F. B. Fitch	Vegetable—Sweet Corn, String Beans.
30.	Mar. 12	Mrs. Helen M. H. Fitch	Vegetable—Carrot Seed.
31.	Apr. 3	J. M. Bragg	Fruit—Gathering and marketing peaches.
32.	Apr. 3	Frank B. Fitch	Fruit—Gathering and marketing cherries, pears, apricots.
33.	Apr. 3	Elsie G. Collins	Fruit—Gathering and Marketing plums, prunes, almonds.
34.	June 11	R. J. Davis	Vegetable—Sweet potatoes.
35.	June 12	—— —— Perry	Goats.

The special four-weeks short courses for teachers will be followed by the inauguration of a regular six-weeks summer school, beginning June 30th. This will be organized on the usual University Summer School plans.

Rehabilitation Courses at the University Farm School.—In response to the request of the Federal Board for Vocational Education, Rehabilitation Division, Western Office, men injured in the national service and entitled to re-education to increase their earning power, were admitted into the regular Farm School courses at the beginning of the second semester, and in the case of a few men special work has been given, notably the teaching of English to two or three Italians whose education had not progressed beyond the equivalent of our third or fourth grade. Special short courses for these rehabilitation men have been established, beginning June 9th, 1919, and will continue throughout the summer. Seventy-six men have so far reported for this work. It is estimated that approximately two-thirds of these men will continue in the regular Farm School course this fall, as a year's training has been authorized for these men. It is understood that men doing good work may have their period of training extended to include the completion of the Farm School course.

Receiving Station Established at the University Farm School.—Pending the time when a soldier applies to the Federal Board for training and his official authorization to enter upon training, the Government desires to support him and keep him busy and the University has agreed to receive these men for this period. They are of three groups; *first,* men desiring training not in agriculture who will be sent to some other institution than the University Farm, but who must wait for formal approval from Washington; *second,* those who are to receive agricultural training but who must wait until the beginning of the regular course; *third,* those for whom it is not known what is the best training to recommend and who must be tried out to ascertain their probable best fitness. To meet the needs of these several groups of men, definite arrangement has been made to keep these men busy during the preliminary period in one or the other of the following activities: creamery work, poultry work, farm machinery (chiefly tractors), blacksmithing, and a combination group in machine lathe and repair work, looking forward to the assignment for retraining along machine-shop lines. Many of the receiving-station men were assigned to the soldiers' short courses. A group of deaf men has been received and are receiving regular instruction under a trained teacher assigned here by the Federal Board. A little work in elementary Americanization is also being given. Total Receiving Station and Short Course men—108.

Products of the University Farm.—As an incident to the conduct of the teaching and investigation work, a considerable business is carried on, which has resulted in the sale of approximately the following amounts of farm products:

Creamery Division, Creamery products	$105,000.00
Animal Husbandry Division, Stock	45,000.00
Farm Division, Grain	4,000.00
Agronomy Division, Seed	1,000.00
Olericulture, Vegetables and Seed	6,000.00
Pomology, Fruit	2,500.00
Poultry Husbandry, poultry and eggs	9,000.00
Veterinary Science Div., services	3,000.00
	$175,500.00

In the case of the creamery, it involves the purchase of approximately $85,000.00 worth of milk and cream; the difference between the purchase price and the sales price being the cost of manufacture and profits.

Crop Yields at the University Farm.—The following are the chief crop yields of the last growing season:

Alfalfa Hay	684	Tons
Barley Hay	98.5	Tons
Wheat	270	Sacks
Barley	1197	Sacks
Silage	343	Tons

Buildings at the University Farm.—During the year there has been completed a packing shed for the Horticulture Division; a building including showers, toilets, wash room, and facilities for washing clothes for the ranch labor; (part of the group including two bunk houses); for the Olericulture Division a small storage house including a cellar; for the Agronomy Division on the Armstrong Tract an implement shed. The above have been built from the funds provided in the Small Buildings and Repair Fund. At the Beef Barn a shed has been added to the east side. The shed for dairy bulls and young stock has been more than doubled in length and corrals built, making possible the segregation of young stock. A milk house, including facilities for cooling milk, separating cream, facilities for washing and sterilizing equipment and a room for testing milk samples has been provided from the Animal Husbandry Special Appropriation.

Student Enrollment at the University Farm School.—The enrollment of students for the current year is as follows:

Farm School	163
University	31
Farmers' Short Courses	298
Teacher Training Courses	28
Short Courses for Soldiers	76
Receiving Station Men	32
Registered Visitors	35
	663

The latter are persons who ask the privilege of spending from a few days to two or three weeks securing such information and instruction as circumstances permit.

Return of National Service Men.—With a maximum enrollment of 314 Farm School students the year the war began, the enrollment dropped last fall to 81, but with the signing of the armistice and the discharge of many men, a large number returned to their studies during the first three months of the calendar year, necessitating much latitude in study lists to enable men to again take up their studies. The return of these men during the spring semester brought the year's enrollment up to 163.

Fair Exhibits.—The exhibit activities of the College of Agriculture during the past year consisted of a presentation, in a clear and forceful way, of the great problem of food production and conservation, as it not only effected the maintenance of our armies in Europe, but the civilian population of many of the allied countries as well. The specific theme chosen was, "The amount of food required to feed one soldier one year, and the amount of food necessary to alleviate the suffering and unrest of the civilian population.'' Around this idea were staged the activities of various divisions, insofar as they contributed directly to the appreciation and solution of this very important war-time problem. The exhibit as a whole was staged at the State Fair in Sacramento and at the Liberty Fair in Los Angeles, where, because of the centralization and character of the department's exhibit its importance was more clearly evident and greatly appreciated, to the extent that a larger service was rendered than in previous years when no central idea prevailed and the department's exhibit occupied small areas in various buildings over the fair-grounds.

A small educational exhibit was also made at the National Orange Show at San Bernardino in which were displayed plates of fruit representing over 125 different varieties of citrus that are fruiting in the variety orchard at the Citrus Experiment Station.

High Quality Livestock.—Some noteworthy records have been made by the Division of Animal Husbandry during the past three years at the International Livestock Exposition in Chicago and the Pacific International Livestock Exposition at Portland, Oregon. The University exhibited cattle and sheep in 1916, and cattle, sheep and hogs in 1918 at the former, and cattle and sheep at the latter in 1917. In each case a very considerable number of the most valuable prizes were won by animals bred and raised at the University Farm. In 1916 the Hereford-Shorthorn steer calf California Favorite, won the grand championship at the International at Chicago, and U. C. Jock, a two-year-old pure-bred Aberdeen-Angus was champion of his breed, and reserve grand champion of the show. In 1917, California Marvel, out of the same cow as California Favorite, was champion steer over all breeds and cross-breeds at the Pacific International Show in Portland. In 1918, this same steer was champion Shorthorn steer at the International at Chicago, and U. C. Jock 3d, a senior calf, was reserve champion Aberdeen-Angus. The fat wethers were strong contenders in all of the classes in which they were exhibited at all three shows, and at the 1918 International a pen of Poland-China barrows was reserve champions of the breed, the pen defeating them being the grand champions of the show. The opinion often previously held and expressed that grand champion animals could only be produced in states where Indian corn forms the basis of the grain ration has been shown to be without foundation, and the importance of breeding stock of marked excellence has been brought home to California breeders in a striking manner.

New Butterfat Record.—Notable among the achievements by animals owned by this institution is the butterfat record of Interested Jap's Santa No. 296928, a pure-bred Jersey cow. She has just completed a yearly record of 15538.2 lbs. of milk containing 940.72 lbs. of butterfat. This is the second time that this cow has broken the state record of the breed, setting a new record last year of 805.72 lbs., which she has exceeded this year by 135 lbs. This places her tenth among all the Jerseys of the country in butter-fat production, and at the top of the list of producers owned by any agricultural college.

Official Dairy Tests.—The official dairy tests conducted under the direction of Woll continue to grow in importance to the breeders and dairy farmers of the state with every year. About 1550 different cows were tested for advanced-registry records during the past year, against 1432 cows in 1916–1917 and 1167 in 1917–1918. These cows were owned by slightly over one hundred different breeders or dairy farmers, some fifty to seventy supervisors having been employed in this work during each year. Tests were conducted for the following number of breeders during the past year: 3 Ayrshire breeders, 13 Guernsey breeders, 23 Jersey breeders, 67 Holstein-Friesian breeders and 1 Milking Shorthorn breeder. As in the past the tests of a great majority of the Holstein cows were of seven or thirty days' duration while tests for yearly records two days each month, were conducted in the case of all other breeds. Many remarkable records of production were made during the past year by California cows.

Space only permits the mentioning of a few of the highest records here. Two cows produced over 1000 pounds of butter-fat during one year, viz: Aaggie Acme of Riverside 2d, 1065.42 pounds, and Tilly Alcartra, 1058.42 pounds, both owned by A. W. Morris & Sons Corp., Woodland. The production of the latter cow for five successive lactation periods has made her the greatest cow of the breed in the country, both as regards milk and butterfat production. In addition to the preceding record, she produced last year 32.627 pounds of butterfat during seven consecutive days, the second highest record in the state, the highest seven day record, 32.813 pounds being that of Adirondack Wietske Dairy Maid (Owner, Bridgford Co., Knightsen). Eight other seven-day records of 28 pounds of butterfat or more, were made during the year. Eleven Holstein cows completed yearly records of more than 800 pounds of butter fat, while six Jerseys and 14 Guernseys produced over 600 pounds of butterfat, the highest records being those made by the Jersey cow, Interested Jap's Santa, 940.72 pounds, (Owner, University of California), and by the Guernsey cow, Belladia, 934.05 pounds (Owner, W. H. Dupee, Santee). For list of highest records of production 1918–19, see pages 110–111.

California Dairy Cow Competition.—A competition for California dairy cows was conducted under the direction of Woll from November 1st, 1916, to February 28th, 1918*. Its main objects were to encourage modern methods in the management of the dairies of the state and to secure records of production for lactation periods of ten months for California dairy cows. Through the liberality of breeders and business firms interested in the advancement of California dairying, a large cash prize fund and many special prizes were secured, aggregating nearly $8000 in value; of this amount over $4000 was set apart for cash prizes for ten-month records and for two series of monthly records. The total number of entries in the competition was 817 cows, of which 231 were pure-bred and 586 grade cows. The average production of cows completing ten-month records was 10,648 lbs. milk and 461.15 lbs. fat; the highest production of milk for this period being 24,201.7 lbs. (Hartog Creamelle De Kol, 135123) and of butter-fat 928.8 lbs. (Aaggie Acme of Riverside 2nd, 164467). Thirty-five per cent of the completed records came above 500 lbs. butterfat for ten months and only two per cent (five cows) came below 200 lbs. The highest records by breeds were as follows:

Ayrshires,	612.06 lbs. butterfat,	Willowmoor Vesta 4th, 34150.
Guernseys,	690.16 lbs. butterfat,	Imp. President's Doris of Lewison, 32145.
Holsteins,	928.81 lbs. butterfat,	Aaggie Acme of Riverside 2nd, 164467.
Jerseys,	703.37 lbs. butterfat,	Interested Jap's Santa, 296928.
Grades,	762.29 lbs. butterfat,	Monte 1st.

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* California State Dairy Cow Competition, 1916–18, by F. W. Woll, Calif. Exp. Sta. Bull. 301, November, 1918, pp. 155–204.

Highest Records of Production, 1918–19

Name of Cow	Breed	Age	Production of Average Milk lbs.	Production of Average Butterfat lbs.	Per cent Fat	Owner
Seven-Day Records:						
Adirondack Wietske Dairy Maid	H.	6–9	831.7	32.813	3.95	Bridgford Co., Knightsen.
Tilly Alcartra	H.	9–3	724.1	32.627	4.51	A. W. Morris & Sons, Woodland.
Boweda	H.	7–5	538.2	30.095	5.59	Bridgford Co., Knightsen.
Miss Valley Mead DeK. W.	H.	3–5	688.6	29.445	4.28	Anita M. Baldwin, Santa Anita.
Ninette Aine Pauline	H.	6–8	544.6	29.076	5.34	Palo Alto Stock Farm, Palto Alto.
Alba Sadie Cornucop. Cr.	H.	9–3	516.7	28.969	5.60	Anita M. Baldwin, Santa Anita.
Spring Farm Pont. Maid 2d	H.	4–9	625.7	28.529	4.56	Bridgford Co., Knightsen.
K. P. Tola Idyl Segis	H.	4–3	510.8	28.489	5.58	McAlister & Sons, Chino.
Changling Tidy Abbekerk Gem	H.	6–11	639.2	28.043	4.39	A. W. Morris & Sons, Woodland.
Creamcup Vogelschen Cornucop.	H.	6–3	342.2	28.026	8.19	K. W. Abbott, Ripon.
Year's Records:						
Aaggie Acme of Riverside 2d	H.	6–1	24690.0	1065.42	4.32	A. W. Morris & Sons, Woodland.
Tilly Alcartra	H.	9–3	33425.3	1058.42	3.17	A. W. Morris & Sons, Woodland.
Aralia DeKol Mead	H.	5–8	23044.6	972.16	4.22	A. W. Morris & Sons, Woodland.
Roxie Paul Burke Heng.	H.	6–3	25175.5	950.59	3.78	Palo Alto Stock Farm, Palo Alto.
Johanna Princ. Mooie 2nd	H.	3–5	25596.5	937.74	3.66	Palo Alto Stock Farm, Palo Alto.
Margaret Aralia DeK.	H.	5–7	22922.7	929.19	4.05	A. W. Morris & Sons, Woodland.
Aralia DeKol 3d	H.	6–2	24554.1	880.38	3.59	A. W. Morris & Sons, Woodland.
Hartog Creamelle DeK.	H.	7–5	27179.4	874.43	3.22	A. W. Morris & Sons, Woodland.
Pauline Cream Mercedes	H.	8–7	25620.8	865.59	3.38	A. W. Morris & Sons, Woodland.
Raphaella Joh. Aaggie	H.	6–4	30637.2	826.73	2.70	State Hosp. Napa.
Hertinga Willis	H.		23969.4	802.70	3.35	W. J. Higdon, Tulare.
Interested Jap's Santa	J.	5–7	15538.2	940.72	6.04	University of California, Davis.
Interested Jap's Santa	J.	4–2	13308.5	805.72	6.05	University of California, Davis.
Fern's Silver Ray	J.	8–0	14692.8	779.54	5.81	F. H. Vanderpoel, Riverside.

HIGHEST RECORDS OF PRODUCTION, 1918-19—(*Continued*)

Name of Cow	Breed	Age	Production of Average Milk lbs.	Production of Average Butterfat lbs.	Per cent Fat	Name
Mermaiden's Fern 2d	J.	5–0	14587.9	725.55	5.00	University of California, Davis.
Irene's Cadora	J.	6–11	13038.6	645.70	4.95	A. A. Jenkins, Tulare.
Mermaiden's Fern	J.	8–2	11816.3	638.71	5.41	University of California, Davis.
Beauty of Walnut Gr.	J.	6–1	12966.5	605.31	4.66	J. E. Wherell, Riverside.
Belladia	Guer.	6–5	19631.9	934.05	4.76	W. H. Dupee, Santee.
Imp. Donnington G. 5th	Guer.	3–0	17861.7	796.32	4.76	W. H. Dupee, Santee.
Imp. Pres. Doris of L.	Guer.	7–0	15478.9	794.85	5.14	Palo Alto Stock Farm, Palo Alto.
Imp. Dawn of S.	Guer.	4–2	13897.8	759.38	5.46	W. H. Dupee, Santee.
Jesebel of Edgemoor	Guer.	2–7	12434.9	748.32	6.02	W. H. Dupee, Santee.
Kitchen Dainty Lass	Guer.	5–8	12797.5	727.50	5.68	Palo Alto Stock Farm, Palo Alto.
Imp. Donn. Jesebel	Guer.	8–2	13219.3	719.00	5.44	W. H. Dupee, Santee.
Imp. Lady of Richm. 3d	Guer.	6–0	12780.4	711.25	5.57	W. H. Dupee, Santee.
Imp. Snowdrop 3d of H.	Guer.	3–2	12881.9	707.08	5.49	W. H. Dupee, Santee.
Mysie's Jane of A. V.	Guer.	7–0	14507.4	657.22	4.53	Palo Alto Stock Farm, Palo Alto.
Imp. Engl. Lady Or.	Guer.	5–7	12471.5	651.87	5.23	Palo Alto Stock Farm, Palo Alto.
Imp. Acadia of L.	Guer.	5–4	9887.2	624.89	6.32	A. J. Welch, Redwood City.
Jessie Ros. of E.	Guer.	2–8	9676.5	614.50	6.35	W. H. Dupee, Santee.
Merry Dance of R. F.	Guer.	6–0	12864.4	607.45	4.72	W. H. Dupee, Santee.

The high records made by many of the grade cows in the competition were especially remarkable. The highest production of butterfat for one year by herds belonging to a cow-testing association was 510.09 lbs. (average for 22 cows); 497.73 lbs. (average for 37 cows); and 420.46 lbs. (average for 53 cows). The records made by cows in the competition, the awards of prizes and discussions of the results obtained, methods of feeding and management of prize herds, etc., are given in the bulletin referred to.

The competition created great interest among the breeders of dairy cattle and the dairy farmers of the state and has doubtless contributed largely towards the advancement of California dairying through the lessons it taught as to the value of modern improved methods in the management of dairy herds. The three most important of these lessons may be briefly stated as follows:

A pure-bred dairy bull at the head of the herd.

Disposal of all "slackers" in the herd.

Feeding the cows so as to secure the highest possible production and net returns from the herd.

California Educational Butter and Cheese Scoring Contest.—Three educational butter and cheese scoring contests were held in different dairy sections of the state during the past year. The first scoring at Tulare was conducted at the plant of the Los Angeles Creamery Company on August 9th, the second at the University Farm during the Buttermakers' Short Course November 21st, and the third at the Gustine Creamery, Gustine, on April 3rd. The total number of entries at these contests was 48 cubes of butter and 8 cheese. A program for practical creamerymen and buttermakers and competitive judging contests were held in conjunction with each scoring.

Examination of Dairy Products.—The following dairy products forwarded to the Dairy Industry Division by residents of the state have been examined and reported upon: Milk and Cream, 163 samples; Butter, 125 samples; Cheese, 23 samples. Commercial scores were placed upon 69 samples of butter forwarded to this Division during the year.

The University Farm Creamery.—The University Farm Creamery is operated on a commercial scale, using the milk and cream produced on the Farm and purchased from dairymen in the vicinity. The products manufactured during the year are as follows:

Butter	124,569 lbs.
Cheese	18,813 lbs.
Ice Cream	3,134 gals.
Cottage Cheese	47,271 lbs.
Condensed whole milk	1,200 lbs.
Condensed skim milk	2,344 lbs.

Coöperative Work.—The Dairy Industry Division coöperated with the State Fair officials in the State Fair Butter and Cheese Scoring, and Milk and Cream Contests in which 76 entries of milk and cream and 31 entries of butter and cheese were examined and scored. The judging of exhibits of all dairy products was carried out by this Division. This Division also assisted the Los Angeles Health Department by furnishing one judge to work with Federal and state representatives at its Quarterly City Milk and Cream Contests. Samples of milk and cream were secured from each distributor within the City of Los Angeles and examined chemically and bacteriologically, and for flavor, visible dirt, and package. This work has encouraged better methods at the dairies, as can be judged from the constant improvement in the quality of milk and cream.

Soil Surveys.—The survey of the soils of California is being carried on by the division of Soil Technology working in coöperation with the Bureau of Soils of the United States Department of Agriculture. The progress of the work was greatly retarded by the war, but since the last report of progress, in 1916, a considerable area has been surveyed. Reconnoissance surveys have been completed covering the middle San Joaquin Valley area, the upper San Joaquin Valley area, and the central southern California area, totaling about 16,550 square miles. This includes about 3,500 square miles which had been covered by earlier detailed surveys. Detailed surveys have been completed covering the El Centro, Grass Valley, Santa Maria, Ventura and Willits areas, totaling 1820 square miles. A net increase of 14,870 square miles of soil survey has been made during this period. The surveys of the middle San Joaquin reconnoissance area and the Santa Maria area have been published, while the others are in press or in manuscript. The published survery consists of a map on which is shown the location and extent of each soil occurring within the area, and a report containing a general description of the area and a detailed description of each soil shown on the map. The map and report constitute a graphic inventory of the soil resources of the state. To date reconnoissance or detailed surveys have been made covering about 25 per cent of the total area of the state, and probably about 60 per cent of the land in farms. See pages 00–00.

A special detailed soil survey of the Agronomy tract on the University Farm at Davis was made by Alfred Smith. This survey showed the variation in the physical character of the soils of the tract, and was used in planning the lay-out of the experimental plots in an endeavor to keep each experiment on a uniform area of soil.

Crop Surveys.—During the progress of the work on the detailed soil surveys, additional data have been collected in the form of a crop map—a map on which is plotted the various crops as they occur during the season of the survey. In the case of perennial crops or of trees or vines there is little change from year to year, but with annual crops the maps are accurate for the year of the survey only. Crop maps covering 4,302 square miles have been completed, but none of the data have been published in full. Data covering the soils in grapes in the Healdsburg soil survey area have been correlated and published. In this area there are about 23,275 acres of grapes, of which 19 per cent have been interplanted to permanent crops, 27 per cent are growing on excellent soils well suited to a wide range of crops, 26 per cent are growing on soils which would give good yields of certain crops, if supplied with water for irrigation, while 28 per cent are growing on lands that are adapted to grass and grain only. There will be a serious loss in production and in land values of this last group of soils when the vineyards are eliminated.

Selection of Land Settlement Sites.—Over forty tracts of land were offered to the State Land Settlement Board as possible sites for the Land Settlement

Colony. These tracts were examined by Shaw, Nelson, and Dean and three were recommended to the Board as suitable for the purpose of subdivision and settlement. Following the selection of the Durham site, Dean made a detailed soil survey which showed that there were seventeen distinct soil types on this tract. The sales value of the different allotments was based, to a large extent, on the results of this survey, the prices varying from $60 to $250 per acre. The soil map and report were freely consulted by the applicants as they were studying the colony and selecting the tracts for their first, second and third choices. Every tract was the first choice of at least one applicant, and there have been no complaints regarding the fairness of the price asked. Thus the settlers themselves have indicated their full approval of the method of evaluating subdivisions on the basis of the actual soil conditions and of paying a fair unit price for the quality of soil purchased.

Wheat Lands.—Continuing the work of the previous year, a list of lands available for lease or purchase for wheat production was compiled, and would-be purchasers or renters were assisted in securing land. Several thousand acres were leased through this effort. Lands in various parts of the state, suggested as possible wheat lands, were examined and reported upon.

Field Crop Investigations.—The investigations of the Division of Agronomy are carried on at three established points, namely, The University Farm, Davis, Kearney Vineyard, Fresno, and at Meloland, near El Centro, Imperial County. Data on fertilizing for wheat and barley have been obtained from field plantings near Stockton and Glendale. In addition to these locations a few coöperative experiments have been located on special tracts.

Notwithstanding the emergencies of the war and increasing prices, the division has continued its main projects, laying emphasis perhaps on those activities that bear upon the larger agricultural problems of the state; such as adaptable crops, rational culture methods and cropping practices bearing on maintenance of fertility.

The division is now transferring the major portion of its work at Davis to a new tract of land known as the Armstrong Tract. This tract comprises about ninety-one acres and will be devoted to investigations related to crop adaptation and improvement, soil management and grass and forage studies.

A portion of the old tract on the University Farm comprising about 20 acres will be retained for work pertaining to irrigated crops. The tract has been piped and motor has been installed. Most of the work on this tract is carried on in coöperation with the Irrigation Division.

Tests of Root Stocks.—The root stock experiments previously reported have been continued. No marked results are apparent, aside from the poor growth made by Bartlett pear on quince stock. Many additional seedling trees of Japanese pear have been top worked to Surprise. Later, these trees will be properly shaped as if for fruiting purpose and all the main branches top-worked to Bartlett. Surprise pear, which is practically immune to pear blight, is being propagated as rapidly as possible for distribution among the fruit growers of the state. A. L. Wisker, a nurseryman of Grass Valley, has donated to the University a collection of five different forms or strains (possibly varieties) of *Pyrus ussuriensis*. These are to be used as root stocks for pears, as they are reputed to be immune to blight.

Pruning Demonstrations.—During the past winter, over 300 fruit growers visited Davis at different times to have a new system of pruning worked out by Tufts, demonstrated to them. These growers came from all over the state, sometimes coming in parties led by a farm advisor, but more often coming in small groups on their own account.

In the state, the staff have conducted a total of approximately 251 demonstrations in pruning and thirty in fruit packing, with an estimated total attendance of 7,200 people.

In connection with the pruning demonstrations, many evening lectures were given. These are not included in the above.

On the University Farm, Picnic Day, April 26, 1919, the Division of Pomology conducted spraying demonstrations, during which the leading makes of spray guns were tested; 125 people saw the demonstrations. A pomology exhibit showed methods of pruning, set of pruning tools, specimens of diseases, root stocks, spraying materials, results of pollination experiments, etc. This exhibit was visited by 850 people, a large number of whom had specific questions to ask on different phases of orcharding.

Development of the Citrus Experiment Station Farm.—The experiment station farm, about 300 acres of which is tillable, came into the possession of the University in 1916. Little development, however, was possible that year. The principle development began in the spring of 1917 and has been continued as rapidly as the funds available would permit. A citrus grove of about 70 acres was planted in the summer of 1917, designed to be used for fertilizer, cultivation and pruning experiments. Each plot in the grove consists of 8 Washington Navel Orange trees, surrounded on each side by guard rows planted with Valencia orange and Marsh Seedless Pomelo, the trees of these varieties alternating in each row. The rate of growth of each tree as indicated by the increase in circumference is being recorded each year. The differential treatments of the different plots will not be installed until the trees are 3 or 4 years old, the plan being to gain some idea of the variability of the trees before the treatments are applied; meanwhile the grove is being treated as nearly uniformly throughout as possible.

The citrus variety orchard on the station farm now contains about 500 different varieties and forms. During the year about two acres have been added to this orchard containing the various types of lemons selected by Mr. A. D. Shamel of the U. S. Department of Agriculture. It was desired to have these types for comparison with the various other varieties under cultivation and also for a comparison of the comparative yields of the different selected types.

A small avocado orchard has been planted during the year containing about 100 seedlings from selected good varieties and also representative trees of the varieties imported from Guatemala by Mr. Wilson Popenoe of the U. S. Department of Agriculture. Several hundred seedling guavas from types selected in Florida by Fawcett and in Hawaii by Webber have also been planted this year in the orchard of subtropical fruits. The avocados and guavas are being grown for the purpose of selecting improved varieties of these fruits. About 130 hybrid peach trees grown from hybrids made by Babcock have also been planted and are being grown to test their value.

An orchard of 8 acres of apricots and pears, together with a small planting of grapes is being grown in a pruning experiment. Other plantings include about 1½ acres of miscellaneous fruits grown for pathological work. The irrigation system has been extended during the year to cover an extra area of about 50 acres that is not yet needed for experimental crops. This will be cultivated in crops to improve the land and should more than pay for its upkeep.

Citrus Fertilization Experiments.—The investigations on the fertilizer requirements of citrus soils and trees are being continued, as careful attention as possible being given both to the practical and scientific aspects of the problem. The results obtained in the two series of experiments, one started in 1907 and the other in 1915, are summarized elsewhere in this report. To supplement these experiments on different soil types coöperative experiments with growers have been started in San Bernardino, Orange and San Diego counties, each of which has been under way several years and is beginning to show differences.

Citrus Breeding.—In the hybridization work conducted by Frost standard varieties have been mainly employed, and special attention has been given to crosses between species, as between orange and mandarin, lemon and pomelo, etc. Over 5000 seedlings are now growing, of which about 4600 are the result of cross pollination, while over 400 are from self pollination of guarded flowers. About two-thirds of these seedlings have been budded on ordinary stocks, mainly in 1918 and 1919. These hybrids, like first-generation citrus hybrids produced elsewhere, are remarkably variable.

Dates.—During the past three years date culture in the Imperial and Coachilla Valleys has grown considerably. This period has demonstrated the possibilities of seedling when properly selected and grown producing excellent fruit. The greatest difficulty has been in rooting the offshoots in quick time and with certainty. Considerable progress has been made in this process by constructing propagating houses where a high temperature and a high humidity can be maintained. Considerable progress has been made in methods of pollination to insure a large setting of fruit and to produce fruits of better size and quality. The proper curing of dates has also been a subject of study. The object to be attained is to reduce the fruit pulp to a concentration of pulp that will preserve it, at the same time to maintain a high degree of sweetness and to reduce the consistency of the skin. Progress has been made in these matters.

It is the object of the Imperial Station to propagate offshoots from the palms on the station grounds which have proved their worth in yield and quality of fruits and to distribute these palms, two or three in number, to the homes of the valley. This would give the homes a distinction as well as afford a supply of fruit for family use.

Peach Breeding Investigations by Babcock and Collins.—Three hundred and fifty-seven trees are growing at Berkeley. Of these 221 are hybrids which have been secured during the course of the investigations, and 136 are species and varieties derived from a number of different sources. Thirteen new varieties from outside sources have been added to the nursery collection of peach varieties and allied species. One hundred fifty new peach hybrids have been secured during the present season (1919). Of seedling varieties previously secured from the hybridization work, 94 are being tested at Davis, 169 at Riverside, and a large number are being grown at Berkeley.

Deciduous Orchard Irrigation Experiments.—A survey by the Division of Irrigation Investigations brought out the fact that the opinions of growers varied widely as to the moisture needs of deciduous orchards at the different periods of tree and fruit growth and ripening. The information available is not sufficiently accurate to be fundamental. What the actual moisture requirements are must be determined by scientific experiments and observations.

A fundamental study of the seasonal water requirements of deciduous orchards and of the relation of soil moisture to their growth and production has been started at the University Farm. One small prune orchard of carefully selected stock on as nearly uniform soil as was possible to obtain, has been planted. A mature orchard of peaches and one of almonds are being carefully studied as to the effect of different irrigation treatments on the development and functioning of the trees. In addition to the work at Davis, seven commercial prune orchards in the Santa Clara Valley are included in a similar experiment.

Veterinary Service.—During the year ending March 31, 1919, 1077 inquiries by stock owners and veterinarians concerning disease in animals have been answered by letter or interview; 386 of these involved reports on the examination of animal or specimens. In addition, numerous trips to various points in the state have been made in response to urgent requests. Other activities may be tabulated as follows:

Anti-hog-cholera serum and virus sold at cost	1,344,875	C.C.
Swine immunized by University veterinarians	6,860	head.
Chicken-pox vaccine sold at cost	231,078	doses.
Cattle tested for tuberculosis	3,213	head.
Bacterial counts on milk samples	266	samples.
Samples of feed tested for poisons	17	samples.

The above figures do not include reports from the University Farm given below.

Health of University Farm Livestock.—During the year 112 animals of all classes have required veterinary attention for various disturbances.

The classes and number of animals so treated are as follows: Horses, 39; Cattle, 44; Sheep, 11; Swine, 14; Goats, 4. There were 28 deaths distributed as follows: Horse, 1; Colt, 1; Cattle, 3; Calves, 6; Sheep, 9; Swine, 8.

No infectious disease has caused serious loss. Preventive vaccination has apparently controlled blackleg, hog cholera, and navel ill in colts. All these diseases have existed on the Farm to some extent in previous years. Navel infection in colts was especially virulent in 1917. Only one case of blackleg appeared during the period of this report. Three cases of wires, nails, etc., passing from the stomachs of cows to vital organs have occurred in the dairy herd during the year. This condition calls for vigilance in feeding clean feed and in keeping such foreign objects picked up around the corrals and feeding boxes.

General Clinics for Student Instruction at the University Farm.—In addition to the clinics furnished by the University Farm animals, those brought in by the stock owners in the vicinity amount to a considerable number. This material offers exceptional opportunity for the students to observe forms of illness, as well as the application of treatment, in farm animals. For the period indicated 2191 animals, including 720 owned by the University Farm, have been treated for disease, immunized, had common farm operations performed upon them or have been tested for tuberculosis. The classes and numbers so treated are as follows: Horses, 126; Cattle, 810; Sheep, 21; Swine, 1194; Dogs, 34; Goats, 6. The students in most cases took an active part in this work.

Hog Cholera.—Since 1913 the reports of serious losses from this disease have decreased from year to year. This is believed to be due to better information among hog owners as to how the disease may be prevented and how losses may be checked after it has broken out. This Station, by a coöperative arrangement with the United States Bureau of Animal Industry, conducts educational and demonstrational work in the prevention of diseases of swine. For the past five years a veterinarian of the Federal Bureau has devoted his entire time to this coöperative work and, in addition, certain veterinarians of the University faculty have devoted a portion of their time to such work.

Hog Cholera Immunization at the University Farm.—The practice of keeping the University Farm hogs immunized against hog cholera has continued and during the period of this report 290 head have been so treated. Immunity from the dams has apparently been sufficient to carry the pigs to past weaning time and to 50 to 75 pounds in weight. At this time it has been the practice to immunize them with serum and virus. The results have been absolutely satisfactory in every respect. No losses have occurred before or after treatment, nor has growth or breeding qualities been unfavorably influenced.

The Manufacture and Distribution of Anti-Hog-Cholera Serum.—In 1911 the State Legislature authorized this station to manufacture anti-hog-cholera serum, and appropriated six thousand dollars to establish a laboratory. An additional annual appropriation of five thousand dollars was made to provide for the free distribution of the serum in 500 c.c. amounts. Hog owners desiring more than this amount were required to pay for the actual cost of its production. On recommendation of the director of this station, the appropriation for the free distribution of serum was not renewed in 1913 and, since that time, all the serum and virus produced have been sold at actual cost of production. The following table gives the statistics of production and cost of manufacture:

	Year	Serum	Virus	Cost per C.C.	Hogs Treated	Average Cost per Head
	Sept. 1, 1911 to June 30, 1912........	469,986	1,159	2½c	20,450	.57
	June 30, 1912, to March 31, 1913..	1,350,235	17,528	2c	52,300	.52
	March 31, 1913, to March 31, 1914	1,079,665	12,815	1½c	38,450	.42
	March 31, 1914, to March 31, 1915	1,687,500	18,662	1c	64,750	.26
	March 31, 1915, to March 31, 1916	1,739,159	23,693	1c	69,945	.25
Av. wt. of pigs immunized 50 lbs.	March 31, 1916, to March 31, 1917	1,615,155	53,461	1⅛c	53,838	.34
	March 31, 1917, to March 31, 1918	1,342,440	37,165	1¼c	44,748	.38
	March 31, 1918, to March 31, 1919	1,294,575	50,300	1¼c	43,152	.38
	Production of Clear Serum—					
	August, 1918 to March 31, 1919	34,125	478	2c S. 1¼c V.	1,137	.60
	Total	10,612,840	215,261		388,770	.36

The laboratory has accomplished the purpose for which it was established, i.e., the introduction to the hog owners of the state of the method of preventing hog cholera by immunization and the instruction of veterinarians in the use of anti-hog-cholera serum and virus. The manufacture of the serum is now thoroughly established commercially with two well-equipped private laboratories in the state and several distributing agencies for Eastern laboratories.

It is the policy of this station to gradually reduce the routine manufacture of the serum in order to enable the members of the staff to devote more time to investigation and extension work.

Inspection of Hog Cholera Serum in California.—Chapter 602 of the California Statutes of 1915, prohibits the sale of damaged or worthless hog cholera serum or virus; and authorizes the director of the station to inspect serum and virus manufactured or offered for sale within the state. Since the United States Department of Agriculture is charged with the enforcement of a similar law regulating the interstate shipment of serums and vaccines; it has been the policy of the station not to issue licenses but to require that a federal license be obtained by manufacturers. The Federal Government maintains a force of four inspectors in the state and ample precautions are taken to insure the potency of such products.

Dairy Certification.—The Division of Veterinary Science continues to have the veterinary, sanitary and bacteriological supervision of the certified dairies around the Bay region for the Alameda County and San Francisco County Medical Milk Commissions. The chemical examinations are made by the Division of Nutrition. This work was started in 1913.

LIST OF DAIRIES AT PRESENT CERTIFIED

Name	Location	No. of Cows Milking		Quarts Produced Daily
H. R. Timm	Dixon	341		3,450
Sleepy Hollow	San Anselmo	220		1,944
Walnut Grove	Santa Clara	132		1,122
University of California	Berkeley	24	Milk	267
			Skim Milk	12
			Cream	3½

Total Certified Milk produced.... 6783

The labor shortage during the war became so acute that the Sleepy Hollow Dairy, with the consent of the San Francisco Milk Commission, installed milking machines. They have been operated with marked success from the bacteriological standpoint. While 6 of 28 bacterial counts were above the maximum limit of 10,000 prescribed, the highest count was only 15,500. This has been accomplished by properly sterilizing the teat cups and rubber tubes with boiling water. With the observance of this technique, it is possible to produce low-bacterial count milk with milking machines. When the rubber parts are are made of good grade of rubber, boiling does not so seriously shorten their period of usefulness as to render its application impractical, which is contrary to the quite generally held opinion on this subject.

Tuberculin Testing in Certified Dairies.—Two tuberculin tests on all cattle of the certified dairies are made each year, using the subcutaneous and intradermal methods alternately. When new purchases are to be made, the entire herds from which they originate must be tested and not over 10% reactors found. This has been termed the 10% rule and was adopted by the Commission in the hope of further safeguarding the certified herds from the introduction of tuberculosis with new purchases of cattle.

Years of observation with the rise and fall of tuberculosis in certified dairies has always shown rises following the purchase of new cattle. It is very difficult to purchase cattle in California under the 10% rule. The additions to one of the certified dairies, with no reactors, were obtained by going outside the state and eliminating all herds with any reactors so that many more animals were tested than were actually purchased. It, therefore, appears that the best way to keep tuberculosis at a minimum in the certified dairies is to have each owner raise sufficient calves to keep up the supply of milk, thus rendering unnecessary the bringing in of cattle from outside sources.

Inspection of Dairies and Distributors.—One veterinary inspection of each dairy is made monthly to observe the health of cattle, the general equipment, methods and sanitation of the ranch.

Also, one sanitary inspection of each dairy is made monthly to observe the general method of technique in cleaning the cows, in milking, bottling of milk and sterilizing of apparatus.

In the East Bay cities, regular weekly visits are made to the distributors' plants, and wagons on the streets are examined to see that the milk is properly iced until it reaches the consumer.

The University Certified Dairy.—On the Berkeley Campus, in Strawberry Canyon, the Division operates the University Certified Dairy. This is a small dairy with 24 cows in the milking barn. It is operated to demonstrate the methods of clean milk production to students and visitors. It is used in the course in dairy bacteriology and sanitary milk production given in the fall semester. The students in this course are required to perform the various operations necessary in the production and handling of the milk as a part of their laboratory exercises. The live stock also furnish some clinical material for the course in elementary Veterinary Science given in the spring semester. There is a total of 47 cattle in the dairy at present, including one pure-bred Ayrshire bull, also 3 horses used for delivering the milk.

During the past year, deliveries were as follows:

	Average Daily Delivery	
Milk	267	quarts
Skim Milk	12	quarts
Cream	6.31	pints

There was a total of 5,256 pounds of butter received from the University Farm Creamery, which was delivered with the milk or cream. Deliveries of butter per month averaged 438 pounds at $.6241 per pound.

Dairy receipts for the last year follow:

Milk	$14,954.88	
Skim Milk	265.67	
Cream	922.80	
Butter	3,280.61	$19,423.96

Farm Labor.—Shortly after war was declared upon Germany, the State Council of Defense charged the College of Agriculture of the University of California with the handling of certain farm labor problems. Later, June 1, 1917, the United States Department of Agriculture vested its emergency war labor work for this state in the same office with R. L. Adams in charge, thus strengthening the office and avoiding duplication of effort.

The work and findings of the office for the crop year have already been published as Circular No. 193, ''A Study of Farm Labor in California.''

During February and March of 1918, a rough survey was undertaken to determine farm labor needs and supplies for the season, to gain an idea of what to expect in the way of a coming shortage of farm labor.

This office devoted, so far as lay within its power, every effort to bring about relief. Many and varied have been the attempted remedies, such as more extended use of retired farmers, high-school and college students, and women. A campaign of publicity by means of special articles and a wide series of meetings aimed to bring about, whenever possible, greater use of the people in the localities and in the work for which they are fitted. Farmers, by utilizing wherever possible this labor, would perform a patriotic duty, because in so doing, they released Japanese, Hindus, Mexicans, and similar labor for use in other sections, and for work not capable of being handled by emergency labor, such as women and children.

The farm advisors were again designated as County Farm Labor Agents, to develop each county's farm labor resources to the fullest possible extent, and to represent this office in the country.

Coöperation was obtained from the County Horticultural Commissioners whereby they unanimously agreed to assist as County Farm Labor Agents in counties needing such an office because no farm advisor was available.

The farm advisors worked under a definite project which clearly defined their duties and field of action and placed upon their shoulders considerable responsibility in carrying out the plans of the College of Agriculture in farm labor matters.

Coöperation with the Y. M. C. A., the California Industrial Welfare Association, the Boy Scout leaders, the Women's Land Army, and various other organizations, was found to be essential in utilizing high-school boys and certain classes of town dwellers.

The College of Agriculture was largely instrumental in bringing about a new coöperative arrangement between the Federal and State Employment offices.

Coöperation between the federal and state employment service was accomplished, and a state appropriation of $15,000 obtained, to be met by an equal amount from the Federal Government. These moneys were used to establish new offices, until a chain of offices was available to the farming districts; the main offices being equipped with a man competent to select farm help, the clearing house feature included, and various local representatives selected to give part time to the farm labor situation in sections not justifying a main office.

This new movement constituted a logical way of finding and supplying help, and relieved this office of the responsibility of actually placing help.

To insure close coöperation, one-half of Mr. T. R. Kelley's time was assigned to the federal department, as special agent.

The full list of the complete arrangement provided for main offices located in the towns of Alturas, Redding, Eureka, San Francisco, Marysville, Sacramento, Stockton, San Jose, Fresno, Santa Maria, Los Angeles, San Diego, Modesto, Bakersfield, and El Centro. Thirty-five sub-offices were located in tributary territory to tie in the less important points.

Land Settlement.—During the past year the Division of Rural Institutions has been mainly engaged in working out plans and policies for creating the things needed to make rural life more attractive and for helping men of small means to become owners of the land they cultivate.

The passage of the California State Land Settlement Act in 1917 was the first step in creating a social land settlement policy. The State Land Settlement Board, aided by the State Agricultural College and other state agencies, was given the task of working out the size of farms, the kind of agriculture, the coöperative organizations and the social institutions that a particular community should have and to do whatever the state could wisely attempt to help settlers succeed.

In working out the plans for this new policy many things not considered necessary in the past have been done. In the preparation for the state land settlement at Durham before the land was sold and in the management of that settlement afterwards it has differed in the following particulars from the methods employed in the disposal of public land or those usually followed in private colonization enterprises.

1. The larger use of scientific knowledge in planning settlements.
    - (*a*) A mosquito abatement district was created and a competent superintendent placed in charge to prevent the creation of malarial conditions.

      Houses have been screened to exclude mosquitoes; all stagnant pools on the settlement have been drained and blood tests of all the settlers taken to determine if any were carriers of malaria.
    - (*b*) A careful soil survey was made and a map prepared showing the variations in soil. This soil map furnished the information chiefly relied upon in fixing the acreage price of farms and by settlers in determining the farm they desired. The acreage price of these farms varied from $48.50 to $235.00.
2. The following financial and other aid was given settlers in improving their farms and in bringing them under cultivation:
    - (*a*) The board bought at wholesale material for houses, farm buildings and fences needed by settlers. This resulted in a great saving to the community.
    - (*b*) Settlers were given expert help in planning houses, in arranging farms and, where desired, these were built under the direction of the board, leaving the settlers free to improve and cultivate their farms.
    - (*c*) Money with which to buy equipment and live stock was loaned to settlers at a low interest rate. Without this many would have had to borrow it from the bank as a personal favor at a high interest rate, or the different developments would have been retarded because of failure to secure the needed money on any terms.

(*d*) The board helped settlers to cultivate and plant crops so that their lands could be brought into cultivation the first year. This service was worth far more than the money cost because doing the work on a large scale permitted the use of better equipment than individual settlers could have afforded.

3. The creation at the outset of social and coöperative organizations has resulted in the development of a remarkable community spirit and has made life more interesting and attractive and greatly increased the income of settlers.

(*a*) All the settlers at Durham belong to a coöperative stockgrowers' association. They have adopted one breed of dairy cattle, one breed of hogs and two breeds of sheep. Only pure-bred sires can be used and these have to be bought or approved by the executive committee of the settlement.

(*b*) The stockbreeders' association is also a buying and selling association. Its executive committee has bought livestock, seed, and implements for the settlers. The settlers sell the milk of their dairy herds as a community. They are arranging for an auction sale of surplus pure-bred stock. In other words, they seek to establish a community reputation and use Durham as a trade name.

(*c*) They have a community center with 22 acres dedicated to community uses. These will include in time a vocational school, a social hall and sports grounds for the community.

4. Speculation in land has been eliminated. Every settler has to reside on his farm. No one can sell without the board's approval. The temptation to trade in land is removed.

5. Twenty-six of the holdings at Durham are the homes of farm laborers. No innovation of the state settlement plans has been more successful. None has been studied with more interest or approval by visitors.

The State Land Settlement Act aroused immediate attention in all parts of this country and in foreign countries. It deals with a world problem made more acute by the world war. Before the settlement had reached the end of its first year it had been visited and reported on by officials of ten American states and five foreign countries.

The Professor of Rural Institutions, who is chairman of the Land Settlement Board, had been invited to explain the act to the legislatures of half a score of states and appeared before five. The soldier settlement bill advocated by Secretary Lane and introduced in Congress by Congressman Mondell and Senator Smoot is based on the California statute. While no state attempted to deal with this subject two years ago, laws to provide for government aid and direction in land settlement were introduced in more than a score of states in 1919.

THE NEW PLAN OF ADMINISTRATION

At its Washington meeting in November, 1917, the Association of American Agricultural Colleges and Experiment Stations adopted the report of its Committee on College Organization and Policy, which reads in parts as follows:

> "8. That the three kinds of service, each in charge of a secondary administrative officer, should be coördinated under a chief executive who, in the case of a large institution composed of several faculty groups, should be an officer other than the president.
>
> "9. That the official designation 'dean' in an agricultural college should be applied only to the chief executive officer who is responsible for the coördination of the three phases of agricultural service, and that of 'director' should be applied to the coördinate officer in charge of each of the three lines of service—resident instruction, research and extension."

Quite apart from this report, the faculty Committee on Reconstruction, appointed by the Dean of the College of Agriculture immediately after the signing of the armistice, to make a study of its several activities and report upon methods of improvement, recommended the ap-appointment of three vice-deans or directors as assistants to the Dean and Director: One Vice Dean or Director of Research, whose duties are defined as follows:

1. To pass upon all projects as regards their being worth the cost in money and time.
2. To pass upon the scientific correctness of the methods to be followed in any project.
3. To decrease duplication of effort.
4. To increase coöperation by Divisions.
5. To insure maximum service in research by studying the needs of the state and the work of the Department as a whole.
6. To advise the individual investigator during the course of his work.
7. To assist him finally in presenting the results in an adequate and convincing manner.

Second, a Vice-Dean or Director of Collegiate Teaching in Agriculture.

Third, Vice-Dean or Director of Agricultural Extension work.

This action lead to the adoption of the following resolution by the Council of Agriculture:

> "The Department of Agriculture recommends to the Council of Agriculture a standing committee to consist of three members representing Research, Resident Instruction and Agricultural Extension, respectively, to be nominated

> annually by the Dean of the College of Agriculture, who shall designate one member to act as chairman of the committee and to be Acting Dean in the absence of the Dean of the College of Agriculture.''

In accordance with this resolution, the Dean of the College of Agriculture nominated the following committee, with titles as indicated, which have been confirmed by the President and Regents of the University:

Walter Mulford, Professor of Forestry and Director of Resident Instruction.

H. J. Webber, Professor of Plant Breeding and Director of the Agricultural Experiment Station.

B. H. Crocheron, Professor of Agricultural Extension and Director of Agricultural Extension.

The Director of Resident Instruction was named Chairman of the Committee. It is hoped that this new administrative organization will not only help to coördinate the lines of endeavor represented by the three directors, but will also result in sustaining the correct relation between the three important phases of the work of the department.

In the Annual Report of the College of Agriculture and the Experiment Station of the University of California for the year ended June 30, 1914, the Director wrote:

> ''The public has been very responsive to the department's instructional work, made possible by the researches of my distinguished predecessors and their able associates. The man who has the ability to present to an audience in a clear and convincing manner the results of investigational work always obtains a satisfactory hearing. The man who understands the details of ordinary practice so as to relate the results of research to actual conditions is especially appreciated. Both types of men are very useful and very necessary to a successful Department of Agriculture. What all of us fail, however, sometimes to understand is that the men who actually extend the realm of knowledge and who, therefore, are in the last analysis the most useful servants of mankind perhaps rarely have any of these qualities. . . . The obvious difference in function between the men of research and the teacher or the men of direct public service creates a difficult administrative problem. The investigator who accomplishes most as an investigator must necessarily be much removed from the public mind. He may spend a lifetime on a problem of the greatest moment and finally leave its proper solution to others. The quicker rewards of other types of service often lure the ambitious man away from his task.''

How true this viewpoint is may be surmised from the simple statement that of the 206 members of the staff recently appointed by the Regents for the fiscal year beginning July 1, 1919, only 47 were connected with the staff at the time the above paragraph was written. Of the staff for the next fiscal year, 29 were not connected with the Department on June 30, 1918. During the fiscal year, 60 persons have submitted their resignations.

The general rise in prices of commodities and wages has greatly reduced the exchange value of salaries paid by educational institutions, which an average increase of ten per cent in salaries granted by this University has not compensated. However, the constant shifting of men is not by any means wholly due to inadequate salaries. All commercial enterprises, including farming in its various phases, take on new life during a period of rising prices. The exhilaration resulting from these activities necesarily appeals to men trained in practical affairs. To keep men happy and contented in the more humdrum work of research and teaching is the important administrative problem. It is to be done by helping them to more effective effort and in greater appreciation of their efforts through many discouragements. To see industries fade away, due to causes that some investigator has spent several years to solve is to him a personal tragedy that is not greatly tempered by the fact that his investigations may show there is no solution to the problem. Such men deserve precisely the same appreciation as the man who attacks a problem that is readily solved and whose application brings new wealth to the state and popularity to the investigator. The easier problems naturally first yield to investigational effort. The more difficult and often the more important remain. As time goes on, it becomes more and more evident that these larger problems are so complex that they can be solved only through the coöperative effort of several divisions of the department or the coöperation of the stations of several states. It is this appreciation of the larger problems and interests involved that is at the base of the new administrative plan. It is the deliberate belief of the members of the department that possible personal credit must be subordinated. Obviously, only an appreciation of the importance of the problem will keep men contented to submerge their own initiative. To give to men the proper opportunity for "self-determination" and yet cause them to contribute toward the solution of a few of the larger agricultural problems of the state is the aim to be achieved.

While the writer was absent from the University on leave from August to December, 1918, in connection with the Agricultural Commission sent to England, France and Italy by the Secretary of Agriculture, David F. Houston, to report on the agricultural conditions of those countries, Professor Walter Mulford acted as Dean and Director. My thanks are due to him for the efficient manner in which he conducted the office during more than a quarter of the fiscal year and for the general supervision which he gave to research work throughout the entire year.

It is a great pleasure also to report that amid the many and serious interruptions to the normal work of the department which everyone gladly accepted in the interests of the greater cause, the staff still retains its enthusiasm for and its appreciation of the research work, which is the basis of all the activities of the department.

In closing, I cannot refrain from expressing my most profound gratification for your personal appreciation and unfailing support of the work of this department during the nearly seven years in which I have been connected with it. Without such guidance, the work would not have been possible.

Respectfully submitted,

THOMAS F. HUNT.

APPENDIX

PROJECTS BEGUN IN PRECEDING YEARS ON WHICH DATA HAVE BEEN ACCUMULATED DURING THE YEAR 1918–19

No. 23. The Intradermal Tuberculin Test for Detecting Tuberculosis in Cattle. By C. M. Haring.

No. 25. A Chemical, Biological and Physiological Study of Alkali in Soils, in its Relation with Crop Production. By C. B. Lipman.

No. 29. Studies on Soil Inoculation with Non-symbiotic Nitrogen Fixing Bacteria on Cropped and Uncropped Soils. By C. B. Lipman.

No. 34. Coöperative Experiments in the Control of Bovine Tuberculosis. By C. M. Haring.

No. 51. Reclamation of Alkali Lands by Flooding and Tile. By C. F. Shaw.

No. 55. Technical Improvements in the Manufacture of Hog Cholera and Virus. By C. M. Haring.

No. 59. A Record of the Results of Hog Cholera Immunization at the University Farm. By C. M. Haring.

No. 61. Certified Dairy Inspections. By C. M. Haring.

No. 63. Bacteriological Examinations of Certified Milk. By C. M. Haring.

*No. 73. Investigation to Find the Relative Values of Soy Bean Meal, Meat-scrap, Buttermilk and O. P. Linseed Oil Meal as High Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty.

No. 92. A study of the Effects of Alfalfa as Exclusive Feed in the Development of the Dairy Calf and Heifer for Dairy Purposes. By G. H. True.

No. 98. Resistant Stocks for Californian Vines. By F. T. Bioletti.

*No. 103. Relation of Degree of Maturity of Grapes to Quantity and Quality of Raisins. By F. T. Bioletti.

No. 104. Resistant Stocks for Raisin Varieties. By F. T. Bioletti.

*No. 105. Wine Grapes for the San Joaquin Valley. By F. T. Bioletti.

No. 114. Preparation of Collection of Olive Trees at Davis, Kearney and Imperial and of Specimens at Berkeley. By F. T. Bioletti.

No. 115. Improvement of Methods of Pickling Olives. By F. T. Bioletti.

No. 119. The Control or Avoidance of Walnut Blight. By R. E. Smith.

No. 160. Death of Animals and cases of Serious Sickness at University Farm. By H. E. Van Norman.

No. 161. Weekly report of work in Progress at University Farm, By Farm Division, Repairs and Power Division and Grounds. By H. E. Van Norman.

No. 173. Fertilizer Experiment. By J. W. Gilmore.

No. 174. Rotation Experiments. By J. W. Gilmore.

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* Work has been resumed on some projects which were discontinued during the period of the war.

No. 176. Variety Trial with Wheat, Barley and Oats in Plots. By J. W. Gilmore.

No. 187. Almond Culture. By R. H. Taylor.

No. 190. Cross-breeding Peaches with Reference to (1) Improved Fruits, (2) Improved Rootstocks, (3) Study of Inheritance in Amygdalus. By E. B. Babcock.

No. 197. Study of the Comparative Infectiousness of the Crown Gall Organism (*Bacterium Tumefaciens*), with Special Reference to Finding Resistant Forms of Prunus Suitable as a Rootstock for the Various Stone Fruits. By C. O. Smith reporting to H. J. Webber.

*No. 250. Investigation as to the Causes, Manner of Development, and Treatment, of Gum Diseases of Citrus and Other Fruit Trees. By H. S. Fawcett reporting to H. J. Webber.

No. 252. Routine Examination of Material Sent to the Citrus Experiment Station, and Minor Studies in Mycology and Bacteriology. By J. T. Barrett and associates.

No. 256. Fruit Spots and Stains. Green Spot, Brown Spot. By J. T. Barrett.

No. 258. The Nematode Problem on Citrus Trees. By E. E. Thomas.

No. 261. The Breeding and Improvement of Citrus Fruits. By H. J. Webber.

No. 262. The Principles of Heredity in Certain Plants. By H. B. Frost.

No. 263. The Origin, Nature and Inheritance of Apparent Mutations in Certain Plants. By H. J. Webber and H. B. Frost.

No. 281. Cultural Experiments with Cotton. By J. W. Gilmore.

No. 305. The Avocado. By J. E. Coit.

No. 311. Investigation to Find the Relative Values of Meatscrap, Digester Tankage, Blood and Bone Meal, Soy Bean Meal, O. P. Linseed Meal, Cocoanut Oil Cake Meal, and Alfalfa Meal as Protein Feeds for Laying and Breeding Hens. By J. E. Dougherty.

No. 313. A Report of Inquiries from Poultry Raisers of California in Regard to Outbreaks of Disease Among Their Flock. By C. M. Haring.

No. 314. Coöperative Extension Work in the Prevention of Hog Cholera in Coöperation with the U. S. Department of Agriculture. By C. M. Haring.

No. 334. A Study of the Rooting Habit of Grape Vines Under Irrigation in the Different Soil Types in Imperial Valley. By F. T. Bioletti.

No. 335. Observations and Studies on Internal Decline. By H. J. Webber.

No. 336. A Study of the Chemical and Physical Effects of Nitrate of Soda on Citrus Soils. By W. P. Kelley.

No. 341. A Study of the Moisture Relations of California Soils, Covering the Moisture Equivalent, Hygroscopic and Coefficient, and Related Factors. By C. F. Shaw.

No. 352. A Study of the Fumigation Process With Special Reference to the Chemical Problems Involved. By H. J. Quayle.

*No. 361. Survey of Situation of the Citrus Products and By-Products Industries in Southern California. By H. J. Webber and others.

No. 362. Inheritance of Quantitive Characters in Tobacco. By E. B. Babcock.

No. 368. Walnut Breeding Investigations. By L. D. Batchelor.

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* Work has been resumed on some projects which were discontinued during the period of the war.

No. 371. Comparison of the Effects of Long and Short Pruning on Varieties Which Are Commonly Pruned Both Ways. By F. T. Bioletti.
No. 375. A Study of the Development of Stands of Sequoia Gigantea. By Walter Mulford.
No. 380. Capri Figs and Caprification in California. By J. E. Coit.
No. 387. A Physiological Study of the Effect of Pruning Upon the Growth and Productiveness of Citrus Trees and Other Horticultural Plants Grown Under Irrigation in Arid Regions of Southern California. By H. S. Reed.
No. 388. A Study of Ammonification and Nitrification in the Soils of Southern California with Special Reference to the Fertilizer Plots of the Citrus Experiment Station. By W. P. Kelley.
No. 392. Effects of Summer Pruning on the Quantity and Quality of the Crop and on the Vigor of the Vine. By F. T. Bioletti.
No. 406. Tests of Chemical Means and Cultural Means for the Control of Wild Morning Glory (*Convolvulus Arvensis*). By C. W. Woodworth and H. E. Van Norman.
No. 409. The Dried Fig Industry in California. By J. E. Coit.
No. 415. Walnut Blight; Investigation for Control. By J. T. Barrett.
No. 440. Irrigation of Vineyards. (Continuation of Informal Coöperation running Since 1911). By S. H. Beckett and F. J. Veihmeyer.
No. 447. A Study of the Growth and Yield of Various Species of Eucalyptus on Different Sites in California. By Walter Mulford.
No. 448. A Study of Trees Suitable for Windbreak Planting on Various Sites in California. By Walter Mulford.
No. 449. Crop Survey of the Russian River Valley. By W. C. Dean, A. Smith and C. J. Zinn, reporting to C. F. Shaw.
No. 455. Sunburning and Winter-killing of Walnut Trees. By L. D. Batchelor and H. S. Reed.
No. 464. Flax Investigations. By B. A. Madson, reporting to J. W. Gilmore.
No. 469. Table Grapes for the San Joaquin Valley. By A. E. Way, reporting to F. T. Bioletti.
No. 470. Pollination Studies. By the Staff of the Division of Pomology.
No. 474. Investigations of the Efficiency of the "Calf-Way" Milking Machine. By F. W. Woll, reporting to G. H. True.
No. 478. Miscellaneous Drainage Investigations. By W. W. Weir, reporting to C. F. Shaw.
No. 479. Soil Survey of Santa Maria Area. By E. B. Watson (U. S.) and A. Smith, reporting to C. F. Shaw.
No. 482. The Use of Pepsin as a Substitute for Rennet in the Manufacture of California (Granular) and Cheddar Cheese. By H. S. Baird.
No. 491. Studies in Soil Moisture. By E. E. Thomas, reporting to W. P. Kelley.
No. 492. The Fruit Bark Beetle. By H. J. Quayle.
No. 495. Studies in Adaptability and Rate of Growth of Trees at the Santa Monica Forestry Station. By W. Metcalf, reporting to W. Mulford.
No. 496. Studies in Adaptability and Rate of Growth of Trees at the Chico Forestry Station. By W. Metcalf, reporting to Walter Mulford.
No. 499. Grape Syrup as a Substitute for Sugar in Canning. By the Division of Viticulture, reporting to F. T. Bioletti.

No. 502. Investigation to Find the Relative Value of Wheat, Hulled Rice and Paddy Rice as Grain Feed and of Wheat Shorts vs. Rice Polish in Mash for Laying Hens. By J. E. Dougherty.

*No. 505. Economical Drying of Wine and Table Grapes. By F. Flossfeder and A. E. Way, reporting to F. T. Bioletti.

No. 506. A Study of the Manufacture of Cheese and Whey. By H. S. Baird.

No. 510. Entomological Field Work. By E. R. DeOng.

No. 511. Preservative Treatment for Wood Silos. By H. L. Belton, reporting to J. B. Davidson.

No. 513. Oat Hay vs. Alfalfa Hay for Skim Milk Calves. By F. W. Woll and E. C. Voorhics, reporting to G. H. True.

No. 514. The Functions of Sulfurous Acid in the Drying of Fruit and in the Storage of Dried Fruits. By W. V. Cruess, F. T. Bioletti and J. C. Whitten.

No. 519. Investigations to Determine the Relative Values of Different Preservative Agents for Storage of Eggs. By W. E. Lloyd, reporting to J. E. Dougherty.

No. 521. The Best Stage of Ripeness at Which to Harvest Fruit for Canning, Drying and the Preparation of Jams, Jellies and other Fruit Products. By F. T. Bioletti.

No. 522. Soil Survey of the Grass Valley Area. By E. B. Watson (U. S.) and J. B. Hammon, reporting to C. F. Shaw.

No. 525. Variety Tests of Fruits for Drying. By W. L. Sweet, reporting to J. C. Whitten.

No. 529. Standardization of Fruit Handling Methods for Drying Purposes. By W. L. Sweet, reporting to J. C. Whitten.

No. 536. Design of Transportable Laying House. By H. L. Belton, coöperating with J. E. Dougherty.

No. 538. The Use of Barley for Laying Hens. By W. E. Lloyd, reporting to J. E. Dougherty.

No. 544. An Investigation to Determine the Relative Effects of Continuous Confinement to the Laying House, Use of Small Yards attached to the Laying House on the Health and Productiveness of Laying Hens. By J. E. Dougherty.

No. 546. New Studies on Nitrogen Fixation. By C. B. Lipman.

No. 547. Skim Milk vs. Whey in Pork Production. By G. H. True.

No. 548. To Determine the Relative Values of Milo in Different Forms, and Milo vs. Barley for Fattening Hogs. By G. H. True.

No. 549. The Use of Bacillus Bulgaricus Starter for Controlling Gassy Milk in the Manufacture of Cheddar Cheese. By H. S. Baird, reporting to C. L. Roadhouse.

No. 550. The Manufacture of Cottage Cheese from a Mixture of Skim Milk and Butter Milk Using Bacillus Bulgaricus Starter for Curdling milk. By H. S. Baird, reporting to C. L. Roadhouse.

No. 551. Genetics of Crepis virens the Smooth Hawksbeard. By E. B. Babcock.

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* Work has been resumed on some projects which were discontinued during the period of the war.

*No. 552. Soil Survey of El Centro Area. By A. T. Strahorn (U. S.) and J. B. Hammon, reporting to C. F. Shaw.

No. 553. Examination of Land Settlement Sites. By W. C. Dean and W. W. Weir, reporting to C. F. Shaw.

No. 554. Survey of Proposed Warm Creek Drainage District. By W. W. Weir, reporting to C. F. Shaw.

No. 555. Field Trials of Fertilizers and Green Manure Crops with Walnuts. By L. D. Batchelor and W. E. Goodspeed.

No. 557. Control of the Citrophilus Mealy Bug. By H. J. Quayle, A. F. Swain and C. R. Perrin.

No. 560. Grasshopper Control in the Plumas and Lassen National Forests. By E. R. DeOng, reporting to C. W. Woodworth. Completed.

No. 561. A Survey of the Principal Warehouses of the State to Locate and Assist in Controlling Injury to Food Products Resulting From Insect Attack. By E. R. DeOng.

No. 562. To Test Devices for Indentification Market Hogs. By G. H. True.

No. 564. Dipping Nursery Stock in C_uSO_4. By R. H. Taylor, reporting to J. C. Whitten.

No. 570. A Study of the Chemical and Physical Properties of Liquid Hydrocyanic Acid. By G. P. Gray.

No. 571. Comparative Values of Various Protein Supplements in Pork Production. By J. I. Thompson, reporting to G. H. True.

No. 573. An Investigation to Determine the Value of Artificial Lighting of Laying Hens to Increase Length of Working Day in Winter and Thus Increase Winter Production of Eggs. By J. E. Dougherty.

No. 575. Preliminary Drainage Survey of Imperial Valley. By W. W. Weir, reporting to C. F. Shaw.

No. 577. The Kaki or Oriental Persimmon in California. By I. J. Condit, reporting to J. E. Coit.

No. 578. Soil Survey of Agronomy Experimental Plots on the Armstrong Ranch, Davis, California. By A. Smith, reporting to C. F. Shaw.

No. 579. A Study of Apricot Gummosis and Its Control. By J. T. Barrett, reporting to H. J. Webber.

No. 580. The Coddling Moth in Walnuts. By H. Knight and H. J. Quayle.

No. 581. Soil Survey of Willits Area. By W. C. Dean, reporting to C. F. Shaw.

No. 582. Soil Survey of Brawley Area. By A. E. Kocher (U. S.), W. C. Dean and A. Smith, reporting to C. F. Shaw.

No. 583. Survey to Determine Feasibility of the Drainage of Little Lake Valley. By W. W. Weir, reporting to C. F. Shaw.

No. 584. Investigation of the Relative Economy of Heavy and Light Grain Feeding for California Dairy Cows. By F. W. Woll and E. C. Voorhies, reporting to G. H. True.

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PROJECTS BEGUN IN PRECEDING YEARS ON WHICH NO DATA HAVE BEEN FILED DURING 1918–19

No. 5. The Immunization of Calves to Tuberculosis with "Bovovaccine." By C. M. Haring.

No. 16. A Systematic Study of the Important, So-called Physiological Diseases of Plants Occurring in California. By R. E. Smith.

No. 21. Study of Hybrids of 1st, 2nd and 3rd Generations Between Various Species of Nicotina, both Wild and Cultivated. By W. A. Setchell.

No. 24. A Study of the Causes and Means of Preventing the Spread of Tuberculosis in Cattle and Hogs in California. By C. M. Haring.

No. 53. Concentration of Hog Cholera Serum and the Precipitation of the Immune Bodies. By C. M. Haring.

No. 62. Tuberculin Testing of Cows in Certified Dairies. By C. M. Haring.

No. 76. Metabolic Experiments with Young Poultry. Protein Experiments. By M. E. Jaffa.

No. 77. Metabolic Experiments with Young Poultry. Corn Protein Experiments. By M. E. Jaffa.

No. 82. Crop Production and Soil Management in Relation to Soil Type at Imperial Valley Station. By J. W. Gilmore.

No. 84. Miscellaneous Plantings. By J. W. Gilmore.

No. 86. Culture Methods for Alfalfa when Used for (1) Pasture; (2) Hay Production. By J. W. Gilmore.

No. 87. Metabolic Experiments with Young Poultry. Barley Protein Experiments. By M. E. Jaffa.

No. 89. Walnut-Oak Hybrids: Study of a New Form of Juglans Californica: Teratology in Juglans Californica; Allied Problems. By E. B. Babcock.

No. 91. Metabolism of Fresh Milch Cows. By G. H. True.

No. 94. Breeding Experiments with Bulbous Plants. By E. B. Babcock.

No. 96. Improvement of Bearing of Fine Varieties by Selection. By F. T. Bioletti.

No. 97. Tests of New of Little Known Varieties of Vines. By F. T. Bioletti.

No. 102. Transmissibility and Degree of Permanence of Vegetative Variation of the Vine. By F. T. Bioletti.

No. 116. A Study of *Armillaria Mellea,* with the Purpose of Finding Practicable Ways to Put an End to Loss from this Fungus Among Trees and Shrubs Attacked by it. By R. E. Smith.

No. 117. Minor Investigations in Plant Pathology. By R. E. Smith.

No. 118. A Study of the Bacterial Disease of Olives Known as Olive Knot, with the Purpose of Discovering the Method of Dissemination of the Causative Organism and the Conditions Governing Infection, the Perfecting of a Practical Method of Control or Eradication and Study of the Pathological Changes Connected with the Knot Formation. By R. E. Smith.

No. 122. A Study of the Factors Influencing Seed Formation in Citrus Fruits. By J. E. Coit. Temporarily deferred.

No. 140. Life Histories (B) Forest Insects. By C. W. Woodworth. Host Relationship.

No. 141. Life Histories (B) Forest Insects. Breeding Cage Work. By C. W. Woodworth.

No. 150. Life Histories (D) Parasites of Human Beings. Mosquito Survey. By C. W. Woorworth.

No. 158. The Pollination of Domestica and Triflora Plums Under California Conditions. By B. B. Pratt.

No. 159. Student Laboratory Plantings—A Study of Fruit Tree Stocks, Pruning and Planting Methods. By W. L. Howard.

No. 166. Effect of the Use of Various Fertilizers on a Vineyard Growing in a Good well-balanced Soil. (In Coöperation with Division of Soils and Fertilizers.) By F. T. Bioletti. Deferred.

No. 178. The Effects of Frost on Vines and Methods of Control. By F. T. Bioletti. Deferred.

No. 180. An Experiment to Determine the Cost of Fitting Beef Cattle for the Show-ring. By G. H. True.

No. 184. Maintenance of Forage Supply in the Mountain Regions of California. By P. B. Kennedy, reporting to J. W. Gilmore.

No. 185. Grass and Forage Plant Garden. By J. W. Gilmore.

No. 186. The Practicability of Growing Vegetables on the University Farm. By H. E. Van Norman.

No. 191. A Study of the Fertilizer Requirements of Citrus Fruits. By H. J. Webber and associates.

No. 193. The Effect of Different Stocks on Commercial Species and Varieties of Citrus. By H. J. Webber and associates.

No. 194. A Study of the Varieties of Citrus Fruits and Their Relatives. By H. J. Webber.

No. 204. The Modification of Soil Flora Through Climatic Influence. By C. B. Lipman.

No. 255. Root Diseases of Citrus Trees. By J. T. Barrett, reporting to H. J. Webber.

No. 265. Citrus Survey. By H. J. Webber and associates.

No. 267. A Study of the Methods for the Determination of Sulfur Dioxide in Dried Fruits. By M. E. Jaffa.

No. 268. Studies in Silage Production. (a) Changes in Chemical Composition of Alfalfa, Oats, Sorghum, Kafir and Milo during the Siloing Process. (b) Losses of Dry Matter and its Components in the Siloing Process in the case of the preceding crops. By G. H. True.

No. 269. The Influence of Barley on the Milk Secretion of Cows. By G. H. True. (Completed.)

No. 272. Variety Trials with Field Peas and Eight Vetches. By P. B. Kennedy reporting to J. W. Gilmore.

No. 275. A Study of the Milk and Cream Supply Furnished to the University Farm Creamery, with the Object of Working out a System of Grading and Paying for Quality. By L. M. Davis.

No. 288. Influence of Methods of Surface Treatment of Soil on Yields. By J. W. Gilmore.

No. 293. Studies in Jelly Making. By F. T. Bioletti.
No. 299. General Survey to Determine Cause and Extent of Water Logging in Imperial Valley. By J. W. Gilmore.
No. 307. Agronomical Plant Collection. By P. B. Kennedy reporting to J. W. Gilmore.
No. 308. Native and Introduced Species of Trifolium in the United States. By P. B. Kennedy, reporting to J. W. Gilmore.
No. 312. Investigation of Roup (Avian Diphtheria) and Chicken Pox (Epithelioma Contagiosum). By C. M. Haring.
No. 320. A Study of the Control of Mould Development in the Cheese Curing Rooms, Dairy Building, University Farm, Davis. Deferred.
No. 322. A Study of Methods of Making Glacé Fruits. By F. T. Bioletti.
No. 327. A Study of Mould Development on Butter Sent to the University Farm by X Creamery. By L. M. Davis.
No. 328. A Study of the Factors Affecting Swell in Ice Cream. By L. M. Davis.
No. 330. Study of the Underlying Factors Influencing Soil Fertility as Evidenced by the Chemical Composition of the Soil Solution. By J. S. Burd.
No. 332. Methods of Preparing Various Fruit Juices. By F. T. Bioletti.
No. 337. Investigations into the Financial Side of Farming as Applied to the Production of Fruit, Field, Cereal and Other Crops of a Similar Nature. By R. L. Adams reporting to J. W. Gilmore.
No. 339. Seasonal Activities of Vine Varieties. By F. T. Bioletti.
No. 349. A Study of the Birth, Weights and Rate and Cost of Gain from Birth to Weaning of Lambs from Ewes of Different Ages and Breeds. By G. H. True.
No. 350. Utility of Winter Spraying in the Control of Vine Mildew. By F. T. Bioletti.
No. 351. Experiment in the Management of Old Groves. By H. J. Webber and associates.
No. 360. Study of Cost Accounting for Citrus Orchards with a View to Determining as Far as Possible the Actual Value of Cultural Practices. By R. S. Vaile.
No. 369. Walnut Root Stock Investigation. By H. J. Webber.
No. 370. Alfalfa and Succulent Feed for Dairy Heifers and Cows. By G. H. True.
No. 374. Investigation of the Co-called Tick Fever in Imperial Valley. By J. W. Gilmore.
No. 377. A Test of Varieties of Fruit for Imperial Valley. By J. W. Gilmore.
No. 378. Variety Tests of Onions. By S. S. Rogers.
No. 379. Variety Tests of Lettuce. By S. S. Rogers.
No. 382. Investigation of the Pickling of Ripe and Green Olives, Including a Study of the Oil Content of Immature and Mature Olives. By M. E. Jaffa.
No. 383. Investigation of the Nutritive Value of Alfalfa Grown in California. By M. E. Jaffa.
No. 385. Planting Distances for Deciduous Orchard Trees. By A. V. Stubenrauch.

No. 386. Variety Tests of Garden Peas. By S. S. Rogers.

No. 389. Apricot Pruning. By A. V. Stubenrauch.

No. 390. Relation of the Number of Vines per Acre to the Quantity and Quality of the Crop. By F. T. Bioletti.

No. 391. Relative Fruitfulness of Canes Originating on Two-Year Old Wood (Fruit-canes) and Canes Originating on Older Wood (Water-Sprouts and Suckers). By F. T. Bioletti.

No. 395. Best Arrangement and Pruning of Vines in a Muscat Vineyard. By F. T. Bioletti.

No. 396. The Design and Construction of Dairy Barns. By J. B. Davidson.

No. 397. The Design of Hog Houses. By J. B. Davidson.

No. 398. Plans for Beef Barns. By J. B. Davidson.

No. 400. Power Required for Plowing. (Beginning of a Study of the Utilization of Power in Agriculture). By J. B. Davidson.

No. 401. Drainage and Paving for Feed Lots. Coöperating with the Division of Animal Husbandry. By J. B. Davidson.

No. 402. Pecan Culture in California. By A. V. Stubenrauch.

No. 403. The Use of Self-feeders in Feeding Dairy Cows. By G. H. True. (Completed.)

No. 404. Equipment for the Storage and Handling of Manure (Preliminary Study). By J. B. Davidson.

No. 405. Spineless Cactus for Milch Cows. By G. H. True. (Completed.)

No. 407. Sudan Grass as a Forage Crop for Sheep. By G. H. True.

No. 408. Table Figs in California. By J. E. Coit.

No. 412. A Study of California Butter (Continuation of Project 340 under the same plan as for 1915). By L. M. Davis.

No.413. A Study of Some Factors Affecting the Texture of Ice Cream. By L. M. Davis. Deferred.

No. 417. An Investigation to Determine the Effect of Time of Hatching on the Molting of Fowls, the Monthly Egg Production and Age of Beginning to Lay, During the Pullet Year. By J. E. Dougherty.

No. 419. Continuous Feeding of Grain to Pigs with Pasture when Available Compared with Alfalfa Pasture Alone When Available and Stubble Pasture in Season. By G. H. True.

No. 420. Detailed Study of Vegetable Garden Work at the Agnew State Hospital. By S. S. Rogers.

No. 421. The Value of Sudan-Grass Silage for Dairy Cows. By F. W. Woll.

No. 422. An Experiment to Determine the Effect of Smutty Wheat on the Health and Productiveness of a Normal Flock of Fowls. By W. E. Lloyd.

No. 423. Control of the House Fly and Stable Fly Upon the University Farm. By E. R. DeOng.

No. 424. Sterilization of Soil with Sodium Cyanide to Destroy Insects, Parasitic Fungi and Weed Seed. By E. R. DeOng.

No. 425. Alfalfa Insects. By E. R. DeOng.

No. 430. Factors Affecting the Cost of Log Making and Skidding. By Donald Bruce, reporting to Walter Mulford.

No. 438. Vegetable Irrigation at Davis. By Frank Adams.

No. 439. Duty of Water in Rice Irrigation in California. By Frank Adams.

No. 441. Irrigation of Orchards and Small Fruits (Davis). By S. H. Beckett and F. J. Veihmeyer.

No. 442. Irrigation Investigations with Field Crops (Davis) Demonstration of Measuring Devices. (Succeeding U. C. Project 167 completed with end of Season 1915.) By S. H. Beckett.

*No. 445. Fixation of Nitrogen by and Nitrification of Legumes. By W. P. Kelley.

No. 452. The value of Alfalfa Silage for Growing Dairy Stock. By G. H. True.

No. 458. Orchard Soils Investigations. A Test of Mulches for Orchard Trees. By W. L. Howard, reporting to A. V. Stubenrauch.

No. 459. Orchard Soils Investigations. Effects of Tillage Practices on Soil Moisture Content and Growth of Trees. By W. L. Howard, reporting to A. V. Stubenrauch.

No. 460. Wool Investigations; Growth and Shrinkage of 6 and 12 Months Wool. By G. H. True.

No. 462. The Cost of Pork Production when Grain is Fed in Conjunction with Alfalfa Pasture. By J. I. Thompson and E. C. Voorhies, reporting to G. H. True.

No. 463. Investigations to Determine Causes of Spotted Growth in Barley Fields. By C. B. Lipman and J. W. Gilmore.

No. 465. The Rancher's Home Vegetable Garden. By S. S. Rogers.

No. 466. Fattening and Marketing Old Ewes. By G. H. True.

No. 467. Demonstration of Method of Growing Raisin Grapes. By S. P. Frissell and A. E. Way, reporting to F. T. Bioletti.

No. 468. Potato Improvement by the Hill Selection and Tuber-unit Method to Determine its Practicability for the Truck Grower. By S. S. Rogers and E. B. Babcock.

No. 471. Fruit-bud Formation and Development. Staff of Pomology, reporting to A. V. Stubenrauch.

No. 472. Studies in Dairy Production by High-producing Cows. By F. W. Woll, reporting to G. H. True. (Completed.)

No. 473. Whole vs. Ground Grains as Feed for Young Dairy Calves. By F. W. Woll and E. C. Voorhies, reporting to G. H. True.

No 475. Preparation of Volume Tables for Principal California Species By Donald Bruce, reporting to Walter Mulford.

No. 477. Cover Crop Breeding. By L. D. Batchelor, reporting to H. J. Webber.

No. 484. To Determine the Relative Value of Milo in Different Forms for Pork Production. By J. I. Thompson, reporting to G. H. True.

No. 485. Skim Milk vs. Whey in Pork Production By J. I. Thompson, reporting to G. H. True.

No. 486. A Study of the Thermal Death Point of Bacillus Botulinus, Especially in Relation to the Sterilization of Canned Vegetables. By W. V. Cruess, in coöperation with the State Board of Health, reporting to F. T. Bioletti.

No. 487. Prune Studies. By Staff of Pomology.

No. 488. The Cumulative Effect of Cropping. By G. R. Stewart, reporting to J. S. Burd.

No. 489. A Detailed Study of the Effect of the Barley Plant on the Soil Solution. By D. R. Hoagland and G. R. Stewart, reporting to J. S. Burd.

No. 490. Study of the Relation of the Concentration of Nutrient Solutions to the Growth of the Barley Plant in Sand and Water Cultures. The Relation of Solution of Absorption and Forms of Combination of Important Elements. By D. R. Hoagland, reporting to J. S. Burd.

No. 494. Manufacture of Concrete Irrigation Pipe. By S. H. Beckett and Roy Wray, reporting to Frank Adams.

No. 497. Methods and Cost of Distribution of Milk with Special Reference to Oakland, Alameda and Berkeley. By E. Mead.

No. 500. A Survey of Utilization of Garbage for Feeding Swine in California. By F. M. Hayes and P. T. Petersen, reporting to C. M. Haring.

No. 501. Increasing the Lamb Crop on the Range. By R. F. Miller, reporting to G. H. True.

No. 504. Canning and Preserving Fruit without Sugar. By W. C. Cruess, reporting to F. T. Bioletti.

No. 507. Drying Vegetables. By F. T. Bioletti.

No. 508. Home Drying of Fruit. By W. V. Cruess and F. Flossfeder, reporting to F. T. Bioletti.

No. 509. Preservation of Vegetables with Salt. By W. V. Cruess, reporting to F. T. Bioletti.

No. 515. The Sugaring of Dried Fruits. By W. V. Cruess, reporting to F. T. Bioletti.

No. 516. New Methods of Packing Dried Fruits. By W. V. Cruess, reporting to F. T. Bioletti and W. L. Howard.

No. 517. A Study of the Maximum Water Content of Dried Fruits. By W. V. Cruess, reporting to F. T. Bioletti and W. L. Howard.

No. 518. A Study of Methods of Fruit Designed to Prevent Darkening of Fruit Dusing Process Without Use of Sulfurous Acid. By W. V. Cruess, reporting to F. T. Bioletti and W. L. Howard.

No. 520. To Determine the Relative Economy of a Limited Compared with a Heavy or Full Grain Ration in Conjunction with Alfalfa Pasture. By J. I. Thompson, reporting to G. H. True.

No. 523. A Study of the Dipping of Fruit Preliminary to Drying. By F. T. Bioletti.

No. 524. Grain Stubble for Sheep. Various Rations for Fattening Sheep. By G. H. True.

No. 526. A Survey of the Deciduous Fruit Drying Industry of the State. By the Staff of Pomology.

No. 527. Effects of Sulfuring on Fruit Tissues and Its Possible Relation to the Palatability of the Dried Product. By W. V. Cruess and W. L. Sweet, reporting to W. L. Howard and F. T. Bioletti.

No. 528. An Experimental Study of the Possible Length of the Storage Period of a Selected Lot of Table Grapes and the Optimum Temperature at Which the Fruit Should Be Held. By R. H. Taylor, reporting to W. L. Howard.

No. 530. An Experimental Study of Equipment for Drying and Curing of Deciduous Fruits on a Commercial Scale. By W. L. Sweet, reporting to W. L. Howard.

No. 531. Effects of Stacking in the Process of Drying Fruit. By W. L. Sweet, reporting to W. L. Howard.

No. 532. A Study of the Comparative Keeping Qualities of Different Varieties of Pears in Cold Storage. By R. H. Taylor, reporting to W. L. Howard.

No. 533. The Keeping Qualities of Apples in Cold Storage as Affected by the Health and Vigor of the Trees. By R. H. Taylor, reporting to W. L. Howard.

No. 534. A Demonstration and Study of the Effect of Degree or Stage of Ripeness of Fruit at Picking Upon Its Behavior in Cold Storage. By R. H. Taylor, reporting to W. L. Howard.

No. 535. The Adaptability of Range Sheep in the Santa Cruz Mountains. By R. F. Miller, reporting to G. H. True.

No. 537. Cost of Producing Lambs on the Farm. By R. F. Miller, reporting to G. H. True.

No. 539. General Irrigation Investigations in California Including office Routine. By Frank Adams.

No. 545. Utilization of Cereal Straw for Feeding Dairy Heifers and Dry Cows. By F. W. Woll, reporting to G. H. True.

No. 558. Intercrops for Deciduous Orchards. By B. A. Madson, reporting to W. L. Howard.

No. 559. Studies on the Nutrition of Plants as Affected by Nitrogen and Sulfur and by Salts. By W. F. Gericke, reporting to C. B. Lipman.

No. 563. Selection and Management of Dry Yards for Curing Fruit. By W. L. Sweet, reporting to W. L. Howard.

No. 565. Curing Prunes. By W. L. Sweet, reporting to W. L. Howard.

No. 566. Effects of Cold Storage on Dried Fruits. By W. L. Sweet, reporting to W L. Howard.

No. 567. Labor Required for Harvesting Alfalfa. By T. Tavernetti and L. J. Fletcher, reporting to J. B. Davidson.

No. 568. Control of Insects in Dried Fruit. By W. L. Sweet and E. R. DeOng, reporting to W. L. Howard.

NEW PROJECTS ORGANIZED SINCE JULY 1, 1918

No. 569. Design of Tank Houses for Land Settlement Board Project. By G. E. Fermery, reporting to J. B. Davidson.

No. 570. A Study of the Chemical and Physical Properties of Liquid Hydrocyanic Acid. By G. P. Gray, reporting to C. W. Woodworth.

No. 571. Comparative Values of Various Protein Supplements in Pork Production. By J. I. Thompson, reporting to G. H. True.

No. 573. An Investigation to Determine the Value of Artificial Lighting of Laying Pens to Increase Length of Working Day in Winter and Thus Increase Production of Eggs. By J. E. Dougherty.

No. 574. Commercial Growing and Breeding of Sugar Beet Seed in Calfornia. By L. D. Batchelor and H. J. Webber.

No. 575. Preliminary Drainage Survey of Imperial Valley. By W. W. Weir, reporting to C. F. Shaw.

No. 576. The Cold Storage of Certain Semi-tropical Fruits. By I. J. Condit and R. H. Taylor, reporting to J. C. Whitten.

No. 577. The Kaki or Oriental Persimmon in California. By I. J. Condit, reporting to J. E. Coit.

No. 578. Soil Survey of Agronomy Experimental Plots on the Armstrong Ranch, Davis, California. By A. Smith, reporting to C. F. Shaw.

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No. 580. The Codling Moth in Walnuts. By H. J. Quayle and H. Knight, reporting to H. J. Webber.

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No. 582. Soil Survey of Brawley Area. By A. E. Kocher, W. C. Dean and A. Smith, reporting to C. F. Shaw.

No. 583. Survey to Determine the Feasibility of the Drainage of Little Lake Valley, Mendocino Co., Calif. By W. W. Weir, reporting to C. F. Shaw.

No. 584. Investigation of the Relative Economy of Heavy and Light Grain Feeding for California Dairy Cows. By F. W. Woll and E. C. Voorhies, reporting to G. H. True.

No. 585. Bean Breeding for Interior Dry-land Conditions in California. By By H. B. Frost, reporting to H. J. Webber.

No. 586. Comparative Value of Various Protein Supplements in Pork Production. By J. I. Thompon, reporting to G. H. True.

No. 587. A Survey of the Waters of the Santa Clara to Determine Their Fitness for Making Oil Emulsions. By E. R. DeOng, reporting to C. W. Woodworth and J. C. Whitten.

No. 588. A Critical and Statistical Study of Long-Time Fertilizer Experiments. The Ohio and Pennsylvania Experiments. By D. D. Waynick, reporting to C. B. Lipman.

No. 589. Design of Rabbit Hutch. By W. E. Lloyd in coöperation with H. E. Belton, reporting to J. E. Dougherty.

PROJECTS COMPLETED AND DISCONTINUED, 1918–19

No. 187. Almond Culture. By R. H. Taylor. Completed.

No. 271. Triangular Soil Exchange Experiment. By J. W. Gilmore. Discontinued.

No. 282. Sudan Grass Experiment. By J. W. Gilmore. Discontinued.

No. 283. Experiments with Non-Saccharine Sorghums, Saccharine Sorghums and Broom Corn. By J. W. Gilmore. Discontinued.

No. 284. Corn Experiments. By J. W. Gilmore. Discontinued.

No. 285. Potato Experiments. By J. W. Gilmore. Discontinued.

No. 286. Bean Experiments. By J. W. Gilmore. Discontinued.

No. 287. Culture Experiments with Cowpeas and Soy Beans. By J. W. Gilmore.

No. 347. Soil Survey of Los Angeles Area. By J. W. Nelson and others, reporting to C. F. Shaw. Completed.

No. 437. Reconnaissance of California Practice in the Irrigation of Deciduous Orchards. By Frank Adams.

No. 450. The Preparation of Land for Alfalfa Irrigation in Northern and Central California. By S. H. Beckett.

No. 451. Pumping for Irrigation. By F. J. Veihmeyer.

No. 461. Miscellaneous Projects. By W. W. Weir. Discontinued.

No. 479. Soil Survey of Santa Maria Area. By E. B. Watson (U. S. D. A.) and A. Smith, reporting to C. F. Shaw. Completed.

No 536. Design of Transportable Laying House. By H. L. Belton, coöperating with J. E. Dougherty. Completed.

No. 540. Duty of Water in Foothills of Yuba and Nevada Counties, California. By J. B. Brown, reporting to Frank Adams.

No. 541. Design and Supervision of Installation of Irrigation Pumping Plant and Pipe Distribution System including Supervision of Preparation of Land for Irrigation for 200 Acres of Farm of Herman E. Berg, near Yuba City, Cal. By Milo B. Williams, reporting to Frank Adams.

No. 542. Irrigation Survey of Portion of Byron-Bethany Irrigation Project in San Joaquin, Alameda and Contra Costa Counties. By M. B. Williams and S. H. Beckett, reporting to Frank Adams.

No. 543. War Emergency Projects. By all members of the force, reporting to Frank Adams.

No. 553. Examination of Land Setlement Sites. By J. W. Nelson, W. C. Dean and W. W. Weir and others, reporting to C. F. Shaw.

No. 556. Use of Water from Kings River. By Harry Barnes, reporting to Frank Adams.

No. 583. Survey to Determine Feasibility of the Drainage of Little Lake Valley, Mendocino Co., Calif. By W. W. Weir, reporting to C. F. Shaw. Completed.

BULLETINS AND CIRCULARS PUBLISHED THE YEAR 1918–19

During the year there have been published 13 bulletins and eleven circulars, in addition to the Director's Annual Report, the Prospectus of the College of Agriculture for 1919–20, the Farmers' Short Courses, September to December, 1919, and nineteen special leaflets and reprints. Altogether 731,500 copies have been printed. The mailing list has increased to over 36,500.

BULLETINS

Bul. 297.	The Almond in California. R. H. Taylor.
Bul. 298.	The Seedless Raisin Grapes. F. T. Bioletti.
Bul. 299.	The Use of Lumber on California Farms. M. B. Pratt.
Bul. 300.	Commercial Fertilizers. P. L. Hibbard.
Bul. 301.	California State Dairy Cow Competition, 1916–18. F. W. Woll.
Bul. 302.	Control of Ground Squirrel by the Fumigation Method. G. R. Stewart and J. S. Burd.
Bul. 303.	Grape Syrup, Preliminary Report. F. T. Bioletti and W. V. Cruess.
Bul. 304.	A Study of the Effects of Freezes on Citrus in California. H. J. Webber and others.
Bul. 305.	The Influence of Barley on the Milk Secretion of Cows. F. W. Woll and E. C. Voorhies.
Bul. 306.	Almond Pollination. W. P. Tufts.
Bul. 307.	Pollination of the Bartlett Pear. W. P. Tufts.
Bul. 308.	Part I. Fumigation with Liquid Hydrocyanic Acid. H. J. Quayle. Part II. Physical and Chemical Properties of Liquid Hydrocyanic Acid. G. P. Gray and E. R. Hurlbit.
Bul. 309.	The Carob in California. I. J. Condit. Nutritive Value of the Carob Bean. M. E. Jaffa and F. W. Albro.

CIRCULARS

Cir. 203.	Peat as a Manure Substitute. J. S. Burd.
Cir. 204.	Handbook of Plant Disease and Pest Control. R. E. Smith, E. O. Essig and G. P. Gray.
Cir. 205.	Blackleg. With New Methods for its Prevention and Treatment. G. H. Hart.
Cir. 206.	Jack Cheese. H. S. Baird.
Cir. 207.	Neufchatel Cheese. H. S. Baird.
Cir. 208.	Summary of the Annual Reports of the Farm Advisors of California, for Dec. 1, 1917, to Dec. 1, 1918. B. H. Crocheron.
Cir. 209.	The Function of the Farm Bureau. B. H. Crocheron.
Cir. 210.	Suggestions to the Settler in California. Thomas Forsyth Hunt and others.
Cir. 211.	Saving Raisins by Sulfuring. F. T. Bioletti and A. E. Way.
Cir. 212.	Salvaging Rain-Damaged Prunes. W. V. Cruess
Cir. 213.	Evaporators for Prune Drying. W. V. Cruess.

LEAFLETS

Some Vegetable Canning Recipes. W. V. Cruess.
Some Pickling Recipes. W. V. Cruess.
Home Preparation of Fruit Juices. W. V. Cruess.

Emergency Farm Labor Agencies. R. L. Adams.
Sugar Saving Suggestions. W. V. Cruess.
Plant Cover Crops Now. V. C. Bryant.
Farmers' Coöperative Marketing Associations.
Grain and Hay Fires in California. Woodbridge Metcalf.

SCIENTIFIC AND OTHER PAPERS EXCLUSIVE OF BULLETINS AND CIRCULARS

Many papers representing work and investigations carried on by the Experiment Station are published in various technical and scientific journals. The following is a list of such articles, prepared by members of the staff, that have appeared during the fiscal year, 1918–19:

ADAMS, R. L.

California Dairy Adjustments. Hoards Dairyman, pp. 613, 638, 639. Nov. 29, 1918.

Orchard Irrigation. Better Fruit, pp. 17, 20–22. Feb., 1919.

BABCOCK, E. B.

Genetics Laboratory Manual. (With J. L. Collins. McGraw-Hill Book Co., N. Y., pp. v-ix and 1–56. Sept., 1918.

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BIOLETTI F. T.

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Practica Viticola Dannosa. L'Agriculture italiano e italosvizzero. Stockton, Calif. Oct., 1918.

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Die-back of the Fig in California. (With H. J. Stevens). Mo. Bull. Calif. St. Com. Hort. Vol. 8, pp. 61–63. Feb., 1919.

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Notes on Recent Work Concerning Acid Soils. (With L. T. Sharp.) Soil Science. In press.

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Cracks and Splits in Oranges. Calif. Cultivator, Vol. 51, No. 17, p. 415. Oct. 26, 1918.

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REPORT OF RECONSTRUCTION COMMITTEE

COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA

To HON. C. C. MOORE, *Director*,
State Council of Defense,
San Francisco, California.

In response to your recent request, enclosing a copy of a letter from Governor Stephens to you under date of November 2d, 1918, the Reconstruction Committee of the College of Agriculture, University of California, respectfully submits the following suggestions and comments, taking them up in the order of the suggestions so clearly outlined by the Governor.

1. **The Development of New Constructional Projects for the Immediate Employment of Our Soldiers After Demobilization and Until They Have Been Distributed Back Into Their Normal Occupations. Among Projects of This Character Are Reservoirs for the Conservation of Waste Waters, the Development of Irrigation and Reclamation Undertakings, Highway Construction, Etc.**

The College of Agriculture believes that the best way to develop new constructional projects in agriculture that will furnish labor to returning soldiers is for the state to encourage and assist in every way possible irrigation, reclamation, and drainage enterprises already existing or being developed through community effort or by the State Land Settlement Board. The demands of war greatly stimulated these enterprises and with the encouragement of the state they can be made an important factor in utilizing surplus labor. The hastening of highway construction, so greatly needed by our agricultural interests, will also materially aid in furnishing opportunities of profitable employment.

3. **Extension of California's Plan of Land Settlement and Colonization. This Plan Makes Provision for Land Settlement Through State Aid and is the Most Advanced Step Taken by Any State along This Line. I Hope that this Splendid Project Will Be Developed so that our State can Offer to Returning Soldiers the Opportunity to Secure Farms and Homes of Their Own.**

The College of Agriculture believes that the development of opportunities for successful land settlement offers the best single means in agriculture for caring for returning soldiers and for absorbing at least a part of the shock incident to industrial readjustment. To this end it favors both a broad National policy of land settlement and a substantial enlargement of state land colonization along the lines of the Durham State Colony, in so far as possible in coöperation with the Federal Government. It stands ready, as at Durham, to place the members of its staff at the disposal of the State Land Settlement Board in the selection and survey of suitable tracts, the development of irrigation and drainage works and practices, the establishment of live stock, horticultural or other interests, and the general development of the communities in any way feasible. If the after-the-war plans along those lines recommended by Secretary of the Interior Franklin K. Lane, as endorsed in the annual message of the President, are made possible by Congress, the College of Agriculture will coördinate its efforts with those of the Federal agencies as well as with the State Land Settlement Board.

While placing the extension of land settlement foremost among desirable reconstruction steps in agriculture, the College of Agriculture believes that any plans made should include careful consideration of the desirability of widening the direct influence of the state in aid of agriculture through irrigation, reclamation and drainage. This influence might be extended in a number of different ways, and with the state assuming different degrees of responsibility, varying from the mere giving of advice by existing agencies to a more thorough administrative supervision, as in the case of irrigation and reclamation districts, or even to the use of state credit or funds in financing the larger projects, with or without coöperation with the Federal Goernment.

It is already clear from past experience and present conditions that the state should lead in the investigation of storage projects for the conservation of water now running to waste. Furthermore, it is plain that the state should have a larger share in the development of community irrigation, reclamation, and drainage projects. To this end the College of Agriculture recommends a substantial appropriation to the State Department of Engineering for making the needed surveys and for coöperating with communities in working out of plans of organization and construction.

Continued Use of Surplus Irrigation Waters:

As war emergency measures the State Railroad Commission in order No. ??? and the Legislature in Act 1732K, respectively, authorized public utilities supplying water for irrigation and mutual irrigation companies and owners of individual irrigation plants to furnish surplus water during the continuance of the war needs without creating rights or incurring obligations as to permanent service. Many thousands of acres were irrigated during 1918 as a result of the act of the Railroad Commission and the Legislature without injury to others. The beneficial results of this have convinced the College of Agriculture that authority should be granted by the Legislature for continuing these emergency provisions and that a similar authority to dispose of surplus water and thus save it from being wasted should be granted to irrigation districts.

4. Labor Problems Resulting from Demobilization—Problems not Only of the Returned Soldiers but of the Men and Women now Engaged in War Work, and in Occupations Affected by the War.

We commend the work of the public employment agencies and urge the extension of the present state-wide system of such agencies to include temporary offices at the points of demobilization of soldiers.

We further recommend that these labor agencies make close study of seasonal farm labor needs in order to better anticipate and supply them.

6. Rehabilitation and Re-education of Returned Soldiers, Utilizing Wherever Possible Existing Public Institutions, Such as the State School for the Blind, Polythechnic Schools, Etc.

To whatever extent war-time experience has impressed the war worker, sailor, soldier or civilian, with the importance of training and education and inspired him with an ambition for agricultural training, be it brief and popular or technical and thorough, the College of Agriculture of the University of California is ready to serve, to the limit of its resources, and to re-adjust, multiply and enlarge its services to meet the demands.

At present it offers five types of agricultural instruction as follows:

1. Correspondence courses for non-residents.
2. Short courses—1 to 6 weeks.
3. University Farm School Course—2 to 3 years.
4. Collegiate courses:
    (*a*) Technical agriculture—4 years.
    (*b*) Teachers' vocational agriculture—5 years.
5. Graduate courses.

In addition to these the College of Agriculture stands ready with tentative plans to develop two additional types of instruction as follows:

1. Short, intensive instruction in supervised farm practice that will enable men without ranch experience to enter at once into practical farming as efficient workers. Groups under the leadership of trained instructors to be assigned to selected ranches for preliminary instruction and work for which part time wages will be paid and increased as skill develops.

2. A three-year course in farm management on the Kearney Park Ranch. A plan already developed contemplates the operation and management of ranches of limited area by small groups of students under the leadership of trained instructors. Detailed plans, showing the equipment, buildings and funds necessary, are on file at the University for use whenever funds can be made available for the enterprise.

In regard to existing courses it may be added that the staff of the College of Agriculture and of the University Farm School are constantly giving thought to the improvement of existing courses and their modification to the end that they may better meet the changing conditions and demands.

7. Development, Through Our Universities and Schools, of Scientific Research and Technical Education as an Aid to Industry.

Beginning in 1875 California was one of the first states to undertake scientific research in agriculture. It has continued steadily since. Additional impetus was given the work by federal appropriations since 1888. In the Annual Report of the College of Agriculture Experiment Station, University of California, for the year ending June 30, 1915, pages 9–43, the Director submits brief summaries of the scientific results secured by the workers of this station.

On pages 29–43 of the Director's report for the year ending June 30, 1916, is shown a resume of the scientific investigations in progress; while on pages 81–119 is to be found an outline of some of the more vital and fundamental problems awaiting solution for want of additional funds to provide workers and facilities for their study.

California has an area equal to the nine North Atlantic states and a diversity of soil, climate and products greater than the original thirteen states, and in addition the problems growing out of the application of irrigation water to arid soils and the transportation of its perishable products to distant markets.

It is apparent that the agricultural research problems of California far exceed in magnitude, diversity and complexity those of any other state, and their study is limited only by the funds it may be expedient to make available.

8. Survey of California's Agricultural Areas to Determine if Land is Being put to its Greatest Economic Use.

A survey of California's agricultural areas to determine if land is being put to its greatest use should consist of, first—a study of the soils to determine their character and quality; second—a study of the water resources to determine the possibilities of irrigation of the dry regions; third—a study of the crop adaptations of the land, to determine the best crops for each region; and fourth—a study of farming methods to determine the possibilities of increasing production by better methods of farming.

In examining the material already available we find that the various State and Federal agencies have accumulated a mass of data bearing on these problems, all of which is available to the public in some form. The subjoined statements (Appendix I) give a brief summary of the sources of material and some of the specific data that have been accumulated.

A soil survey of the state will be completed in about six or more years, assuming the same rate of progress as that maintained before the war, and this, with the data compiled from the classification of the lands of the National Forests and the Public Lands will form the basis of a comprehensive report of the soils of California. With sufficient increased support the survey could be completed and made available for publication within four years. In the same way irrigation and related investigations may be materially hastened. We recommend the continuation of the work now in progress, together with further support and extension of the work along such lines as may be deemed necessary or desirable in order to meet the demands of the emergency. We would specifically recommend the prosecution of a survey of the pasture and range lands of the state as already outlined by the University of California (See Appendix for plans) to determine the possible ways of improvement and better utilization of these lands, and we would also recommend the extension of the soil and crop survey work in the state.

The investigation of crop adaptations has been started and a study of methods and means of solving the problems involved is being made.

The varied problems of crop production occupy the major portion of the time and efforts of the entire staff of the College of Agriculture and Experiment Station and of the investigators of the U. S. Department of Agriculture who are working in California (see appended statements) and an immense amount of information has been collected and made available.

In order that all this information may be made immediately accessible as needed and in order to insure coördination, eliminate waste and duplication, we recommend the organization within the Council of Defense, Food Administration, and the College of Agriculture of a standing committee to deal with the questions that may arise relating to our agricultural lands and their better utilization.

10. Organizing California's Agricultural, Horticultural and Other Industries for Increased Production and to Provide Plans for Quickly Assembling and Marketing Products.

We believe the farm bureau to be the best type of farmers' organization yet devised to increase food production. County farm bureaus have been in process of organization since 1914 under the Smith-Lever Act of Congress which Act makes an appropriation to be met by equal sums from the states for the installation of farm advisors to work with the county farm bureaus. These funds automatically increase year by year until 1922 when they will reach their maximum and furnish a farm advisor to practically every agricultural county of America.

At the outbreak of the war, the system was only partially completed, there being only fifteen county farm bureaus and farm advisors in California. It was evidently in the minds of Congress and of the Secretary of Agriculture that it was desirable to have a governmental agency in every agricultural county in the country in order to secure the necessary food production, for among the first emergency acts of Congress was that providing an appropriation to the U. S. Department of Agriculture to immediately increase the number of these county farm advisors, one for every agricultural county in America—thus accomplishing in one year the development of a system which normally would have taken several years. Since it was not deemed feasible to secure appropriations from the states quickly enough to carry one-half the burden as heretofore, the Federal Government provided funds to carry the entire enlargement of the enterprises during the war period. Thus the enlarged farm advisor system of California has not cost the state a dollar more than the small system contemplated before the war.

The installation of additional farm advisors necessitated the formation of as many new farm bureaus. California rose to the necessity at the request of the Federal Government. The Governor, the Council of Defense and the University launched a campaign to create farm bureaus in every agricultural county of the state with the result that the number of farm bureaus and farm advisors was increased from fifteen to thiry-four. These now cover 85% of the farms of the state and have more than 20,000 farmers in membership. During the war period the farm bureaus have been the official agency recognized by the Federal Government through which its food production program was furthered.

During the year from December 1, 1917, to December 1, 1918, fifteen thousand farmers asked the county farm advisors to visit their farms to give advice. The farm advisors held five thousand meetings with a total of two hundred thousand people in attendance. At the call of the Federal Government, the farm bureaus waged special campaigns to induce the farmers to plant crops especially necessary at the time. To meet immediate emergencies, wheat campaigns, sheep campaigns, hog campaigns, etc., were conducted with notable success due to the willing response of the farmers to this new federal and state agency. The total cost of the state and federal governments for conducting this enterprise during the present fiscal year will be $258,000, of which $50,000 was contributed by the state of California and $208,000 by the federal government. Thus, while during the pre-war period the organization was financed by the state and federal governments on a dollar per dollar basis, the federal government now contributes four dollars for every one from the state. It is extremely unlikely that this situation will continue; the expectation being that Congress will require each state to meet half the expenses of the enterprise after the present fiscal year which expires June 30th next.

Since the augmented farm bureau system in the state was promoted by the State Council of Defense as one of its war agencies, it should be determined:

(1) Whether the State Council of Defense desires this system continued as now, or even developed still further, or whether it desires the farm bureau system to decrease to the fifteen counties to which before the war it was restricted by lack of funds.

(2) Whether the State Council of Defense believes Congress should make its appropriations through an increase to the Smith-Lever Act whereby funds would come directly to the state for their expeditures upon a dollar per dollar basis, and

(3) Whether the State Council of Defense believes the state of California through its Legislature should make provision to meet half the expense for the continuance and possible expansion of this farm bureau system as a part of the post-war enterprise of the state.

Marketing. As an aid to the quick assembly and handling of products, we desire to draw attention to the fact that diversification of California farming is most desirable in order to promote the permanence of our agriculture and the prosperity of small farmers and that such diversification is rendered difficult by inability to market small lots of produce. We therefore recommend the rapid extension of the state and county highway systems and the encouragement thereon of motor truck transportation. We believe that such motor trucks could gather up small packages of produce at frequently located platforms for transmittal to addresses in nearby towns and cities; thus making it possible to quickly market directly to the city consumers small farm products which would otherwise be wasted.

The following is a brief summary by the Chairman of the Reconstruction Committee of the foregoing report, which report has been approved by the staff of the College of Agriculture. The actions recommended are:

1. For the returning war worker, insure him easy contact with the agencies that will direct him to
    - (*a*) Employment (4).
    - (*b*) Education (7).
    - (*c*) Land Ownership (3).
2. Recommendations that require legislative action:
    - (*a*) Enlarged highway construction (1).
    - (*b*) Increased reclamation, irrigation and drainage (3).
    - (*c*) Appropriation to State Engineer's Office for larger share in community irrigation, reclamation and drainage projects (3).
    - (*d*) To permit future use of surplus water without increasing permanent rights (3).
    - (*e*) Increase funds for agricultural surveys now in progress if the emergency need of the survey prompts greater haste in their completion (8).
3. The College of Agriculture is ready:
    - (*a*) To coöperate further in land settlement and development (4).
    - (*b*) To modify and adapt courses of instruction to meet emergency needs (4).
    - (*c*) To develop new types of instruction (4).
4. Policies which the State Council of Defense should advocate, promote or inaugurate.
    - (*a*) Indorse the policy of Secretary Lane for land reclamation and settlement by federal and state coöperation (3).
    - (*b*) Increase the state's active influence in irrigation, reclamation and drainage work, even to the extent of state credit and funds (3).

(*c*) Extension of public labor agencies and their establishment at points of demobilization (4).

(*d*) Increase funds for agricultural research (7).

(*e*) Appoint committee of Council of Defense, Food Administration, College of Agriculture, to make more available the accumulated agricultural survey material.

(*f*) Shall the farm bureau system, as now organized, continue? (10).

(*g*) Should Congress increase the appropriation by the Smith-Lever act? (10).

(*h*) Should California undertake to meet one-half the expense for the continuation of the farm bureau system? (10).

Respectfully submitted,
H. E. VAN NORMAN,
Chairman.

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